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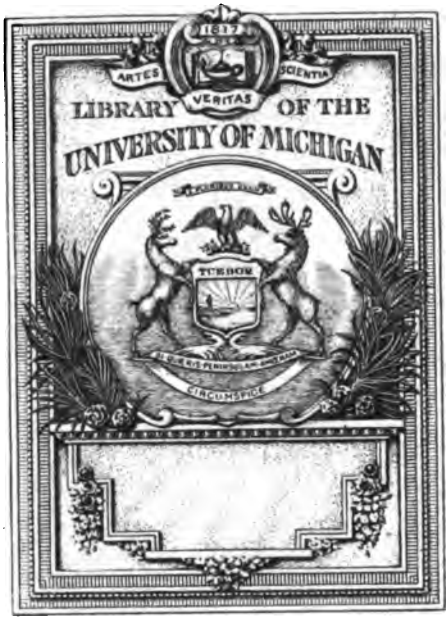
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PROCEEDINGS

OF THE

AMERICAN PHILOSOPHICAL SOCIETY,

HELD AT PHILADELPHIA, FOR PROMOTING USEFUL KNOWLEDGE.

Vol. XVII. May to December, 1877. No. 100.

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[*Continued on 4th page of Cover.*]

AMERICAN PHILOSOPHICAL SOCIETY,

1878.

JANUARY 4, ANNUAL ELECTION OF OFFICERS,

Between the hours of 2 and 5 o'clock, P. M.

STATED MEETINGS OF		
OFFICERS AND COUNCIL.	SOCIETY 7 o'clock, P. M.	STATED BUSINESS OF THE MEETING. (*Chair taken at 8 o'clock.*)
	Jan. 4.	Election of officers reported. Librarian nominated.
	Jan. 18.	Librarian and Standing Committees chosen. Catalogue of members read. Candidates for membership balloted for.
	Feb. 1.	
Feb. 8.		
	Feb. 15.	Proceedings of Officers and Council submitted.
	Mar. 1.	
	Mar. 15.	
	April 5.	
	April 19.	Candidates for membership balloted for.
	May 3.	
May 10.		
	May 17.	Proceedings of Officers and Council submitted.
	June 21.	
	July 19.	Candidates for membership balloted for.
Aug. 9.		
	Aug. 16.	Proceedings of Officers and Council submitted.
	Sept. 20.	
	Oct. 4.	
	Oct. 18.	Candidates for membership balloted for.
	Nov. 1.	
Nov. 8.		
	Nov. 15.	Proceedings of Officers and Council submitted.
	Dec. 6.	Reports of Treasurer and Publication Committee. Communications for Magellanic Premium considered at this or the next stated meeting.
	Dec. 20.	Report of Finance Committee. Appropriations for the succeeding year passed.

OFFICIATING SECRETARIES AND CURATORS.

Secretaries.—J. L. **LECONTE**, P. E. **CHASE**, for January, March, May, July, September, November.

G. F. **BARKER**, J. P. **LESLEY**, for February, April, June, August, October, December.

Curators.—**HECTOR TYNDALE**, for January, April, July, October.

CHARLES M. CRESSON, for February, May, August, November.

DANIEL G. BRINTON, for March, June, September, December.

☞ 1879. January 3, ANNUAL ELECTION OF OFFICERS, between the hours of 2 and 5 o'clock, P. M.

PROCEEDINGS

OF THE

AMERICAN PHILOSOPHICAL SOCIETY

HELD AT PHILADELPHIA

FOR

PROMOTING USEFUL KNOWLEDGE.

Vol. XVII.

JUNE 1877 TO JUNE 1878.

PHILADELPHIA:
PRINTED FOR THE SOCIETY
BY M'CALLA & STAVELY.
1878.

PROCEEDINGS

OF THE

AMERICAN PHILOSOPHICAL SOCIETY.

VOL. XVII. · JUNE TO DECEMBER, 1877. No. 100.

Stated Meeting, May 20th, 1877.

Present, 12 members.

Vice-President, Mr. PRICE, in the Chair.

Prof. Geo. Stuart and Dr. Rothrock, newly-elected members, were introduced to the presiding officer and took their seats.

A letter accepting membership was received from Mr. J. Douglass, dated Phœnixville, Pa., May 8, 1877.

Letters of envoy were received from the R. Academy at Amsterdam, December 1, 1876, and from the U. S. Department of the Interior at Washington.

Letters of acknowledgment were received from the R. A. Amsterdam, January 6, 1877 (95, 97); B. S. N. H., May 10, 1877 (96, 98); Dr. Green, Lib. Rensselaer Pol. Inst., May 11, 1877 (Cat. I–II.).

Donations were received from the R. A., Amsterdam; Ger. Geol. Soc., Berlin; Zool. Gart. Frankfort; N. H. S. Leipsig; R. A. d. L., Rome; Vaudois Soc. Lausanne; Geog. Soc. and Rév. Pol. Paris, and Nov. Met.; B. H. N. S.; Mr. Hubert Howe Bancroft, of New York; Mr. W. E. Dubois; Penn Monthly; Med. News and Lib. Philadelphia; Coms. 2d Geol. Sur. Pa.; Howard University, Washington, D. C.;

U. S. Dep. Interior; Botanical Gazette, Logansport, Ind.; Kansas State Hist. Soc.; Mr. H. S. Scudder and Mr. Archibald Liversidge, Sydney, Australia.

Prof. Cope presented a communication for the Proceedings entitled, "On the Reptilian Bone Bed in East Illinois. By E. D. Cope;" illustrated the interesting points of the paper, and the doubtful character of the horizon of the formation from which the remains were obtained; but leaned to the view that it was of Permian age. The vertebræ of these reptiles are perforated, showing the existence of a *chorda dorsalis*, a character unknown in living animals except in one New Zealand genus.

Prof. Cope communicated also a paper "On some new and little known reptiles and fishes, from the Austro-riparian region of the United States;" explaining the boundaries of the region, &c.

Nominations 836, 837, 838, were read.

And the meeting was adjourned.

Stated Meeting, June 15th, 1877.

Present, 17 members.

Vice-President, Mr. **Fraley**, in the Chair.

Dr. Morehead, a newly elected member, was introduced to the presiding officer and took his seat.

Letters of envoy were received from the Observatory at Turin, dated May 17; the Obs. Harvard Coll., June 5; and the Department of the Interior, May 27, 1877.

Letters of acknowledgment were received from the Asiatic Society of Japan (93 to 97); the R. Acad. Linc., Rome (XII, XIII, i, ii, XIV, XV, i, ii, and Proc. Vols. 8 to 14); Institute of Luxembourg, May 5 (95, 97); R. Astron. Society, May 9 (96, 98); Soc. of Antiquaries, London, May 11 (96, 98); London Statistical Society, May 11 (96, 98); and the Victoria Institute, May 8 (96, 98).

[illegible]

Vol. 17, no. 100-101

Donations for the Library were reported from the Mining Bureau at Melbourne; School of Mines at Ballarat; R. Danish Society; Imp. Academies at Berlin, Vienna and Bruxelles; the Scientific Club at Vienna; Art Union at Ulm; R. Observatory at Turin; M. Aless. Dorna; R. Acad. at Rome; M. F. De Saussure and Rev. Pol. Paris; R. Society, R. Institution, R. Ast. Society, Meteor. Committee, and Nature, London; Lord Lindsay; Canadian Journal of Sciences, Toronto; B. S. N. History; Observatory at Harvard College; Amer. Chemist; Franklin Institute, Acad. Nat. Sciences, Jour. Pharmacy, Med. News, Penn Monthly, and Zoological Society at Philadelphia; Prof. E. D. Cope; Mr. Horace W. Smith; Mr. Joel A. Allen; the U. S. Fish Commission; U. S. War Department; Mr. Edwin A. Barber; Botanical Gazette of Logansport, Ind.; Wisconsin State Historical Society; M. Barcena, of Mexico; and Silliman's Journal.

A copy of the Proceedings, No. 99, just published, was laid upon the table.

The death of Mr. Edmund Quincy, a member of the Society, was announced by the Secretary.

Dr. Sadtler read a paper entitled, "Dichlorsalicylic Acid, by Dr. Edgar F. Smith, Ph.D."

Pending nominations Nos. 836, 837, 838, were read.

The chairman of the Committee on the Wootten process, Dr. R. E. Rogers, read the following report:

The Committee to whom was referred the examination of Mr. John E. Wootten's method of utilizing coal dirt from the waste heaps in the anthracite mining regions by the Resolution of the Society of November 17, and December 1, 1876, respectfully report:

Unanimously, that the method of Mr. Wootten as exhibited to them is meritorious and successful.

But they disagree as to its originality; and they therefore prefer to refer the question of the award of the premium to the Society.

Signed by R. E. Rogers, Wm. A. Ingham, J. Blodget Britton, Robert Briggs and Geo. F. Barker.

After a full statement of their individual opinions had been made by the members of the Committee who were present, Dr. Rogers moved the following Resolution:

Resolved, That in view of the originality, merit and success of Mr. Wootten's process for utilizing coal waste, Mr. Wootten be awarded the premium above referred to.

After discussion on which resolution it was

Resolved, That the Report be recommitted to the Committee, with instructions that all competing methods be considered by the Committee which shall be presented to its consideration within three months after public advertisement by the Society in two city papers once a week for three weeks; the function of the Committee being clearly understood to be to report on the success, the originality, and the merits* of the process.

And the Society was adjourned at 11 o'clock, P. M.

Stated Meeting, July 20th, 1877.

Present, 16 members.

Vice-President, Mr. FRALEY, in the Chair.

Prof. H. Draper, a newly-elected member, was introduced to the presiding officer and took his seat.

Visitor, Mr. Wallace, of Ansonia, Conn.

A photograph of Mr. Sears C. Walker was received from the Smithsonian Institution, for the album.

Letters of acknowledgment were received from the R. S. of Tasmania, Dec. 27, 1876 (92, 93, 94); R. D. A. Copenhagen, June 16, 1877 (96, 98); N. H. Union at Bremen, July 1, 1877 (96,* 98) (* asks for 97 not received); A. d. L. Rome (97); Trübner & Co, London, June 29, 1877 (96,* 98); N. Hampshire Hist. Soc. July 2, 1877 (99); and the Chicago Hist. Soc. June 14 and 29, 1877 (94, 95, 96, 97, 98).

Letters from the R. Acad. Berlin, June 15, July 2, were received, requesting missing pages Proc., Vol. VII, pp. 121–163, and Vol. IX, 1870, plates 6, 7, 8.

A letter from the Bureau of Education, Washington, D. C., was received, requesting replies to inquiries respecting meetings and publications.

---

* Mr. Briggs wished the attention of the Society to be drawn to a clerical error in the printed Proceedings of December 1, 1876, whereby the word "merits" was omitted.

Letters of envoy were received from the R. Norw. University; K. K. Z. B. G. Vienna; N. G. Bamburg; and the U. S. Depart. Interior, Washington.

Donations for the Library were received from the R. S. Tasmania; Phys. C. Obs. St. Petersburg; R. Nor. Univ. Christiania; K. K. Geol. R. Vienna; Anthro. G. and K. K. Z. B. G. Vienna; D. Geol. G. Berlin; K. L. C. A. D. N. Dresden (with a letter requesting a renewal of the old correspondence*); Ed. Haus und Landwirthschaft Kalendar, Munich; V. f. K. u. A. Ulm; N. H. G. Bamburg; A. d. L. Rome; Portuguese Commissioners to the Centennial Exhibition; S. de Geog., Ed. Annales des Mines, and Révue Politique, Paris; R. A. Brussels; Astronomical Society, Royal S. of Antiquaries, Zoological Society, and Nature, London; R. Cornwall Pol. Society; N. H. S. Newcastle-upon-Tyne; Director of Geol. Survey, Canada; Ed. Canadian Journal of Science; Essex Institute; A. Acad. A. and S.; Boston N. H. S.; Mass. State Board of Health; S. H. Scudder, Cambridge; Ed. Science Observer, Boston; Am. Jour. Science and Arts; Yale College; Geol. Survey New York, Prof. Hall, Albany; Young Men's Association, Buffalo; Acad. N. S. Philadelphia; Franklin Institute; Jour. of Pharmacy; Jour. of Med. Sciences; Med. News and Library; Penn Monthly; E. D. Cope, Philadelphia; Peabody Institute, Baltimore; Dep. Int. Washington; Chicago Acad. Sciences; Ed. Botanical Gazette, Ind.; M. Barcena, Mexico.

* On motion of Dr. LeConte, it was resolved that the Kais. Leopold. Carol. Academie at Dresden be restored to its place on the list of correspondents, and that it be supplied with all missing volumes of Transactions and numbers of Proceedings as far as possible. (See Mar. 3, 1876.)

Dr. Draper read and explained a paper, entitled "Discovery of Oxygen in the Sun by Photography, and a new theory of the Solar Spectrum, by Prof. Henry Draper, M.D."

Prof. Barker expressed his pleasure at hearing this paper, which in his opinion was the most important contribution to Solar Physics made in America in this century. Granting the fact of the existence of *bright* lines in the solar spectrum, and no one after seeing Prof. Draper's photographs on collodion could doubt the fact, all the new views expressed in this paper follow as a matter of course. The bright lines are not only clearly apparent when looked for, but are numerous.

Mr. Chase joined in the tribute of merited admiration for Dr. Draper's brilliant discoveries, and suggested that a possible explanation for the different action of different elements might be found in differences of density and elasticity.

W. M. Hicks (L. E. and D. P. Mag, June 1877), by special assumptions, and by a mistake in calculation (see his note in P. Mag. July 1877), obtains the ratio $\frac{c'}{c} = 1.423$. He says: "If, then, the two atoms of a molecule have separated, there seem only two ways of accounting for it. Either their relative motion becomes so large as to overcome the force of attraction, or some external force must act upon them, which can be nothing less than a reaction between them and some other molecule. The latter is the hypothesis I have adopted in the following investigation." My own ratio, based on relative motions (Proc. Am. Phil. Soc., xiv., 651), is $\frac{c'}{c} = 2\pi^2 \div (\pi^2 + 4) = 1.423$. This coincidence is, of course, purely accidental, but it is none the less curious. The reasoning upon which it was based seems to justify both my own views of the kinetic energies in perfect gases, and Hicks's view of the importance of temperature relations in coercible gases.

In a mass, like the Sun, which is presumably at or near the point of dissociation, gaseous permanence and gaseous density would both contribute to a change of elliptic into linear radial oscillations, which would have acquired their mean velocity at points ranging between about 180,000 miles, and 260,000 miles above the Sun's surface. It is, therefore, quite possible, especially if hydrogen is metallic, that oxygen, carbon, and other nonmetals, may have greater centrifugal tendencies than hydrogen and metallic vapors. Perhaps spectroscopic observations near the Sun's poles may present some contrasts with equatorial observations, which will help towards a settlement of the question.

Prof. Barker communicated a "Note on the exactitude of the French normal fork; a reply to the paper of Mr. A. J. Ellis; by Rudolph König, Ph.D," of Paris; and said that the matter was one of great importance; for if Mr. Ellis' attack could be sustained no confidence could be placed in and therefore no use could be made by physicists of the large and valuable instruments in the physical laboratory of the University of Pennsylvania made by Dr. König, of Paris. He was happy, therefore, to be able to place on record so complete a refutation of the unwarranted assertions of Mr. Ellis by the aid of Prof. Helmholtz and Prof. Meyer of Hoboken.

Prof. Lesley communicated a paper, entitled "Note on the probable derivation of *Μακαριος* from the Egyptian formula *Maχeru* after proper names," and explained his views of the appearance of such sacerdotal terms in early times on the monuments of Egypt and in later times in the literature of Greece and Rome. He suggested the possible etymology of *ολβιος*, *ολβιοδαιμων* (=*ευδαιμων*) from the Egyptian *alp*, *arp*, vine, wine, in the sense of *jucundus*, joyous; while *μακαρ* corresponded to the Hebrew *barak*, *beatus*, blessed. In like manner the *tat* of the monuments reappears in the Latin *tutus*, safe, secure, permanent, unshakeable, and possibly in *totus*, the cosmos, or established order, &c.

Prof. Chase suggested a mode of reaching the demonstration of bright lines in the solar spectrum by mathematical relations between four elementary formulæ of the solar system based on the nebular hypothesis.

Prof. Cope communicated two papers, entitled, "On a new species of Adocidæ from the Tertiary of Georgia;" and "Tenth Contribution to the Herpetology of Tropical America; by E. D. Cope."

Upon a report from Mr. E. K. Price, Chairman of the Committee on the Michaux Legacy, it was

Resolved, That three copies of the Journal of Forestry be subscribed for, out of the Michaux Legacy; one for the Society; one for the Professor of Botany, Lecturer in the Park; and one for the use of the Committee on the Michaux Legacy.

On motion of Prof. Barker, a vote of thanks was passed to Prof. Draper for the gift of the excellent illustrations accompanying his paper.

Pending nominations Nos. 836, 837, 838, were read and ballotted for, and on a scrutiny of the ballot boxes, the following persons were declared duly elected members of the Society:

Mr. H. C. Humphreys, Chemist, of Philadelphia.
Prof. I. I. Sylvester, of Johns Hopkins Univ., Baltimore.
Mr. John Ericsson, of New York.

And the meeting was adjourned.

Stated Meeting, August 17*th*, 1877.

Present, 8 members.

Secretary, Dr. LECONTE, in the Chair.

Letters acknowledging the receipt of Proceedings, 94 to 99, were received from the R. Observatory at Greenwich; the Radcliffe Observatory; Philosophical Society of Liverpool; the East Tennessee University; Poughkeepsie N. H. Society; Wisconsin Hist. Society; Library of Congress; Public Library of New Bedford; Library of Yale College; Northern Academy of Hanover, Ind.; U. S. Coast Survey Office; American Journal at New Haven; Linnean Society at Lancaster; Buffalo N. H. Society; Prof. L. Rütimeyer, John L. Campbell, C. F. Brackett, C. E. Dutton, W. A. Hammond, E. Goodfellow, T. L. Kane, Thomas Hill, P. F. Rothermel, R. S. Williamson, Jos. LeConte, John LeConte. Cleveland Abbe, J. F. Clarke, Joseph Henry, M. F. Longstreth, Jas. D. Dana, and C. A. Young, now of Princeton.

Donations for the Library were received from the R. Academies at Berlin and Brussels; the Antiquarian Society at Copenhagen; M. Chabas; M. L. Hugo; the Geographical Society and Révue Politique, Paris; the Observatories at Madrid, Mexico, Buenos Ayres and Cordoba; the R. Astronomical and Zoological Societies and London Nature; the Philosophical Society at Glasgow; the Canadian Naturalist; Government of Canada; Peabody Museum at Cambridge; Appalachian Club; American Antiquarian Society; Whelpley and Storer; Silliman's Journal; Mercantile Library of

New York; N. J. Hist. Society; Franklin Institute; Jour. of Pharmacy; News and Library; Penn Monthly; Mr. T. Meehan; U. S. Weather Bureau; Botanical Gazette, Hanover, Ind.; B. S. Lyman, Tokei; and Prof. A. Liversidge, of Sydney, N. S. W.

The death of Prof. Dr. Frederick August Tholuck, at Halle an der Saale, June 10, aged 78 years, was announced, with remarks by the Secretaries.

The death of W. Timothy Abbot Conrad, in Trenton, N. J., August 8, aged 73 years, was announced, with remarks by Prof. Cope.

Dr. Genth read his eleventh contribution from the Laboratory of the University of Pennsylvania, entitled "On Some Tellurium and Vanadium Minerals; by F. A. Genth."

Prof. Cope exhibited and described some recently discovered fossils, one of which was a cast of a gar-pike, of supposed late tertiary date, to which he assigned the provisional name, *Clastes cuneatus*—a possible link between the extinct and living genera of that family.

He communicated also a paper, entitled "On some new or little known Reptiles and Fishes of the Cretaceous, No. 3, of Kansas, by E. D. Cope."

Mr. Briggs added some points to his previous paper on the *Vena contracta*, and made some remarks on the omission from text-books of the elementary fact that, whereas an unsystematically balanced fly-wheel runs steadily and without injury to its housings so long as its rate of rotation suffers no change, the contrary is the case when its rate is retarded or accelerated.

The minutes of the last meeting of the Board of Officers and Members in Council were read, and it was then, on motion,

Resolved, That the thirteen applications for the premium for a coal-dirt burning apparatus offered by the Society, thus far received, be referred to the Committee considering the award of the premium; and that the Committee be requested to prepare a proper form of advertisement in accordance with a recent resolution of the Society.

On motion it was ordered that the name of the Davenport Academy of Sciences be placed on the List of Correspondents to receive the Proceedings from the year 1870 onwards.

And the meeting was adjourned.

Stated Meeting, September 21st, 1877.

Present, 12 members.

Vice-President, Mr. **Fraley**, in the Chair.

Visitor, Mr. A. E. Carpenter, of Philadelphia.

Letters accepting membership were received from Mr. John Ericsson, dated New York, July 1; from Mr. H. C. Humphrey, dated Seabrook, Conn., August 10; from Prof. J. J. Sylvester, dated St. John's College, Cambria, August 11; from Prof. James Geikie, Perth, Scotland, August 14, 1877.

A photograph for the Album was received from Mr. James Geikie.

Letters of acknowledgment were received from Prof. Steenstrup, Copenhagen, August 31 (99); Royal Zoological Society, Amsterdam, July 14 (96, 98); M. Henri de Saussure, Geneva, August 15 (96, 98); Bureau des Longitudes, Paris, July 18 (96, 98); Royal Society, Edinburgh, August 8 (96, 98); Natural History Society, Northumberland, &c., August 22 (96, 98).

Letters of envoy were received from the Royal Society of New South Wales, July 11, 1877; S. de Geographie Commerciale de Bordeaux, June 1; Meteor. Office, London, July, 1877; Mr. H. S. Eddy, Cincinnati, Ohio, August 28.

A letter was received from Mr. Ludwig Mejer, Secretary of the Natural History Society of Hanover, informing the Society, that Nos. 96 and 98, sent to Prof. Stromeyer, had been given on the death of that member of the Society to the Society in Hanover, and requesting that the gift be confirmed, and the transmission of Proceedings be continued on the basis of exchanges.

On motion the title of the Nat. His. Society of Hanover was ordered to be placed on the list of Corresponding Societies to receive the Proceedings.

Donations for the Library were received from the Department of Mines, Victoria, N. S. W.; Imp. R. Academies at Berlin, Rome and Brussels; the Society at Augsburg; Geographical Society and Annales des Mines, and R. Politique at Paris; Society of Antiquaries; Nature and Cobden Club, London; Boston S. N. H.; Silliman and Dana; College of Physicians, Penn Monthly, Franklin Institute, Amer. Jour. of Pharmacy, Medical News, and E. D. Cope, of Philadelphia; Mr. John Ericsson of New York; Prof. H. D. Eddy of Cincinnati; and the Mexican Meteorological Observatory.

The death of Prof. Louis Stromeyer, at Hanover, in August, 1876, was announced by the Secretary.

The death of Mr. Robert Were Fox, at Falmouth, England, July 25, in the 88th year of his age, was announced by the Secretary.

Prof. Sadtler communicated verbally his personal observations of collections of so-called Paraffine from around the pipes and bore holes of the Oil region, and his laboratory demonstration that it was a mechanical emulsion of gas and water condensed upon the surfaces from which it is collected.

Prof. Sadtler promised soon to give the finished results of his investigations in the Laboratory of the University into the nature of the natural gases emitted by the oil wells. He has already discovered that the higher hydro-carbons of the marsh gas series are really present in these gases almost universally.

A description of the Spouting Wilcox Well, No. 1., in McKean county, by W. Charles A. Ashburner, of the Geological Survey of Pennsylvania, with a graphical representation of the time, order, and height of a series of jets from it, was read by the Secretary.

Mr. Briggs explained why and how this phenomenon of paroxysmal ejection from a bore hole can only occur in case the upper section of the hole has a larger diameter than the lower.

The first of the series of colored geological county maps of Pennsylvania, in preparation by Mr. Julius Bien of New York, to illustrate the reports of progress of the Assistant Geologists of Pennsylvania, viz: a map of Fayette county, was exhibited by the Secretary, who said that its chief value consisted in its careful differentiation of the Coal Measures into four series, its exhibition of all the isolated patches left by erosion, and, in general terms, the completeness of its outcrop lines, carefully traced as they had been by its author, Prof. J. J. Stevenson, on foot, throughout the district. A copy of the old geological State map of 1842 (published in 1858) was exhibited to show the contrast, and the progress of our knowledge of local geology of the State, as well as to illustrate the different way in which the second survey of the State can be carried on, owing to more fortunate circumstances.

Prof. Chase placed upon the blackboard some of his results in a search (by request of Professor Draper of New York) for some harmonic series of lines in the solar spectrum. He gave the coincidences which appear in the case of the Gold lines, the Barium lines, and especially of Frauenhofer's dark lines, and concluded with an earnest protest against the assumption that such coincidences can be merely accidental.

Pending nomination No. 839 was read.

The following report was read by Mr. Price, as Chairman of the Committee on the Michaux Legacy:

"At a meeting of the Committee on the Michaux Legacy, of the Amer. Phil. Society, held September 8, 1877, present F. Fraley, Eli K. Price, Wm. M. Tilghman, and J. B. Townsend, it was

"*Resolved*, That out of the reserved interest of the Legacy, trees from Fairmount Park be planted in the grounds of the University of Pennsylvania, not to exceed in cost one hundred dollars ($100).

"*Resolved*, That it is recommended to the Park Commissioners to supply the trees for the above purpose, as far as suitable, from importations made by the Society's appropriations to the Park Commission out of the Income of the Michaux Legacy."

On motion the report was accepted and an appropriation of one hundred dollars ($100) was made to meet the expenses indicated therein.

On motion of Dr. Rushenberger it was

Resolved, That the Curators be requested to inquire into the expediency of depositing the collection of implements illustrative of the Stone Age, bequeathed to the A. P. Society by the late Mr. Franklin Peale, in care of the Academy of Natural Sciences of Philadelphia.

And the meeting was adjourned.

Stated Meeting, October 5th, 1877.

Present, 12 members.

Vice-President, Mr. FRALEY, in the Chair.

Letters of acknowledgment were received from the Teyler Museum at Harlem (96, 98, 99); and the Glasgow Phil. Society (99).

Letters of envoy were received from the Depart. of Interior, Washington, September 27; and the Museum at Mexico, August 18, 1877.

Donations for the Library were received from the Society at Ulm; the Academy at Brussels; the Révue Politique; British Association; Geological Society, Meteorological Society, and London Nature; from the Essex Institute; Boston S. N. H.; Silliman and Dana; Cornell University; Franklin Institute; College of Pharmacy; Dep. Interior and Signal Service Office; and the Museum and Observatory in Mexico.

The death of M. U. J. J. LeVerrier, at Paris, September 23, 1877, aged 66 years, was announced.

A communication entitled: "Level Notes and Compass Courses of the Seaboard Pipe Line, from the mouth of Black Fox run, Clarion county, Pa., to Patapsco river, near Baltimore, Md. Lines run by O. Barrett, Jr., C. E. Western Division; B. F. Warren, C. E. Middle Division; J. B.

Haupt, C. E. Eastern Division; Gen. Hermann Haupt, Chief Engineer;" was received from Gen. Haupt.

In handing in this communication the Secretary explained the object of the survey, and the high value attaching to this the first accurately measured and leveled section across Pennsylvania and Maryland; the use it will be to the topographical and geological surveys of the State; and certain features both of resemblance and contrast which it presents to the long sections across the State prepared from less accurate data in 1841, and published in 1858.

Another communication on the same subject was received from Mr. O. Barrett, Jr., C. E., entitled: "A list of elevations above mean tide through the county of Indiana in Pennsylvania; from notes of survey under Gen. H. Haupt, for the Seaboard Pipe Line."

Pending nomination No. 839, and new nominations Nos. 840, 841, 842 were read.

The following Report of the Curators was read by Dr. Cresson:

"The Curators respectfully report in reference to the deposit in the Academy of Natural Sciences of the Stone age Relics, received from Mrs. C. E. G. Peale, that they consider that for the present it will be a proper disposition of the collection. They recommend, that after proper assurance that the building of the A. N. S. is fire-proof, in accordance with the terms of the bequest, the transfer be made, subject to the usual agreement as to return upon demand. The following letter from Mr. Patterson, Executor, assures the Society that thi proposition has his concurrence, and that they shall not be put to expense for making the transfer or setting up the relics in cases.

"PHILADELPHIA, October 2, 1877.

Messrs. Tyndale and others, Curators of the A. P. S.

Gentlemen: –Referring to the Proceedings of the Society on November 19, 1875, in reference to the bequest of Stone-age Relics made by Mrs. C. E. G. Peale, I ask your further consideration and that of the Society to providing a place of deposit for the collection where it may be open to the inspection of the public.

"Mrs. Peale's bequest is conditioned on the collection being lodged in a fire-proof building; and it now lies in the building of the Philadelphia Saving Fund Society, but is boxed up so as to be unavailable for examination. This disposal of the collection, while technically in compliance with the Will, does not carry out what I know to have been the wishes of the testatrix. I would respectfully suggest that an arrangement could probably be made with the Academy of Natural Sciences to receive the collection as a deposit by the Society. If that can be done, I would cheerfully bear the necessary expense of making the transfer and setting the relics in the cases.

Yours respectfully,
ROBERT PATTERSON,
Executor."

On motion of Dr. Cresson, it was then

Resolved, That the Curators be directed to transfer the collection of Stone-age Relics, received from Mrs. C. E. G. Peale, to the custody of the Academy of Natural Sciences, in accordance with their recommendation of this date.

Dr. Rogers made an explanation in behalf the Coal Slack Premium Committee, stating that the absence of members of Committee during the summer holidays had made a full meeting of the Committee difficult to obtain; that consequently no action had been taken by the Committee on the Society's resolution of August 17, to advertise the Premium; that, nevertheless, Mr. Briggs, one of the Committee, had given extensive publicity to the intentions of the Society through his own private correspondence and by an article in the Iron Age, which he read; and he desired therefore to know whether further advertisement would be deemed necessary.

In the course of the debate which ensued, and at one stage of which Mr. Fraley left the chair for the purpose of participating in it, Mr. Price taking the chair for the rest of the evening, Mr. Briggs offered the following resolution:

Resolved, That the following advertisement be made public, signed by the Secretaries:

"Premium for the successful utilization of Anthracite Coal Dust.

"The American Philosophical Society of Philadelphia having voted to offer a premium of $500 'for the successful utilization of anthracite coal dust, to be competed for under rules of the Society,' public notice is hereby given that applications for the premium will now be received, and that all such as may be presented within three months of the date of this advertisement will be considered as competing for the same.

"In considering the award for premium the Society will not only require that the process presented shall successfully accomplish the result, but that the utilization shall be shown to be advantageous and profitable in the general markets for anthracite coal, and shall have become a practical substitute for what is now considered merchantable anthracite.

"Where the claim for the premium is made upon any alleged invention or discovery, the priority or originality of such invention or discovery will be investigated, and no premium will be awarded except to the first inventor or discoverer; but when the claim is founded upon the successful introduction by the adaptation of known processes the award will be made to the person or persons who shall have effected the public use primarily and extensively.

"Any person may apply for this premium by letter addressed to the American Philosophical Society, and the primary application need only state the nature of the process, or ground of claim, and the address of the applicant.

"Such application will then be referred to a Committee of the Society before whom the full statement of the facts can be made, and by whom they will be considered and reported upon for action of the Society in making the award.

Dr. Rogers moved that all after the word "Resolved" be stricken out from Mr. Brigg's resolution, and the following be substituted:

Resolved, That no advertisement shall be made until a basis be determined by the Society on which its award of premium shall be made.

Pending debate on which, both resolutions were withdrawn by the movers, and Mr. Fraley offered the following resolution, which was accepted by Mr. Briggs and Dr. Rogers as a substitute for their own respectively, and was passed:

Resolved, That the Secretaries of the Society be requested to prepare and submit to the Society at the next stated meeting a form of advertisement for applications for the premium on "Any successful process by which the Anthracite Coal-dust may be economically utilized." (See Proc. A. P. S., Vol. x. p. 278.)

And the meeting was adjourned.

Stated Meeting, October 19*th*, 1877.

Present, 12 members.

Vice-President, Mr. Price, in the Chair.

A photograph of M. Mariano Barcena was received for the Album.

Letters of acknowledgment were received from the

On the results of Surveys in 1876-7 *made for the purpose of Rectifying the System of Rail Road and Oil Well Levels throughout North West Pennsylvania.*

BY J. F. CARLL, ASSISTANT GEOLOGIST IN CHARGE OF THE SURVEY OF THE OIL REGIONS.

(*Read before the American Philosophical Society, May* 4, 1877.)

No attempt has heretofore been made to compare and adjust the levels of the numerous lines of Rail Roads interlacing the Oil Regions; consequently considerable misapprehension exists, not only as to the true ocean levels, but also as to the relative levels of many places frequently quoted and taken as points from which to calculate the fall of the surface and streams, or the dips of the oil rocks.

Within this district not one point of elevation has been *proven* to be correct. Harrisburg, Pittsburgh and the surface of Lake Erie are the nearest reliable points we have; and their true heights above mean ocean level have only recently been fixed through the well directed and successful efforts of Mr. Jas. T. Gardner, Geographer to the United States Geological and Geographical Survey of the Territories, under the charge of Dr. F. V. Hayden, United States Geologist.

These elevations above mean surface of the Atlantic Ocean—Harrisburg 320′, Pittsburgh 745′, and Lake Erie 573′—are now adopted; and from them we propose to carry forward the Rail Road lines of this district, to compare their intersections and junctions, and to fix and adopt certain points of elevation on which to base our geological work.

This, perhaps, should have been one of the first tasks of the Survey, but the material for it could not at that time have been immediately obtained, for even now after working towards the point for three years, much is wanting to make the adjustment as complete as could be wished.

The road most closely connected with the work of this district, is the Pittsburgh, Titusville and Buffalo Railway. It passes through the heart of the Oil Regions, along the valleys of the Allegheny River and Oil Creek from Pittsburgh to Corry and thence over the "divide" to Brockton. Unfortunately, its levels have been very unreliable; not so much, as we discover, now, from inaccuracy in the original instrumental work, as from a want of care in adjusting the datum planes of the several roads composing the present continuous line, to ocean level.

The elevation of Oil City, based on these levels has been variously given from 995′ to 1049′ above tide.* Other places along the line have varied in the same manner, but not to so great a degree.† There was also a want of agreement with the railways intersecting it, at the West Pennsylvania

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* Meaning mean *high* tide at Philadelphia, Pennsylvania Rail Road datum; mean *tide* at Baltimore; mean *tide* at New York (Via Lake Erie), &c.

† Except at points like Driftwood on the Philadelphia and Erie Rail Road.

Rail Road Junction ; at Red Bank ; at Parker's ; at Oil City ; and at Corry. In 1875 the engineers in charge of the A. V. R. R. re-leveled its track from Kittanning up to South Oil City, but their work was based on the Kittanning bench-mark, the true elevation of which was in doubt. So that previous to the commencement of these examinations and our adjustment of the levels, we had not been able to secure a single elevation along the A. V. R. R. on which it seemed safe to rely.

As the shortest way out of these difficulties, and to establish some reliable base for the use of the survey, a re-leveling of the road, as far as might be necessary was resolved upon. Accordingly, early in February 1877, Mr. John H. Carll and Mr. Arthur Hale, provided with a superior rail road level and staff, proceeded to Pittsburgh to commence the work.

Every facility was afforded by the Chief Engineer of the Railway, Mr. H. Blackstone, to whom our thanks are due for these courtesies, for the examination of profiles and note books, and all the data of use secured from the office of the Rail Road Company.

Our levels were commenced at the Union Depot bench-mark and carried forward continuously to the old Kittanning bench-mark. A table comparing the results with a Railway profile, is appended. It shows a difference of only $\frac{92}{100}$ of a foot between the Railway profile elevation of the Kittanning bench-mark and our own ; and establishes the height of this bench at 809.94′ above mean surface of the Atlantic Ocean.*

From Kittanning to South Oil City there is a rise of 299.20′ according to the Rail Road levels of 1875. But in a table of elevations furnished the Smithsonian Institution by the engineer of the road shortly after its completion, the difference between the same points is given as 298′. The levels of 1875, consequently, make the elevation of South Oil City 1009′, the old levels 1008′.

From W. Pennsylvania Junction our re-leveling was carried on up the Butler Branch Rail Road, to Great Belt City. Here connection was made with our line run along the oil belt by Messrs. Hatch and Hale in 1875 and by Messrs. Chance and Hale in 1876. This last named line was then adjusted to the Pittsburgh datum, traced back to Parker's depot and found to coincide there within $\frac{4}{10}$ of a foot with the Allegheny Valley Rail Road, corrected elevation—thus showing a very reliable circuit from Allegheny Junction to Great Belt, from Great Belt to Parker's and from Parker's back to Allegheny Junction. So far the levels appear to be satisfactory.

From Parker's to Oil City, the following check was kindly furnished by Mr. D. Jones Lucas, Resident Engineer of the Union Pipe Company. Mr. Lucas ran a line of levels across the country in 1875 from Parker's depot to Oil City (Union Depot), and found the difference in elevation to be 118.9′. This added to our accepted elevation of Parker's 889′, gives 1008′ as the proper height of Oil City (U. Dep.) which is 0.45′ lower than the South Oil City Depot.

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* As established by United States Coast Survey in New York Harbor.

We now have these figures, using the decimals for Union Depot, Oil City.

By levels of 1875, Kitt. bench..........809.94 + 199.20 — 0.45 = 1008.69
" Old levels " " ....809.94 + 198.00 — 0.45 = 1007.49
" Mr. Lucas, Parker's Depot.....................889.4 + 118.90 = 1008.30

It seems safe therefore to accept 1008′ as the established elevation of this point.

Our levels thus adjusted to Oil City, the next step was to connect the termini of the several Railroads centering there, with the Union Depot. When this was done the following rather discouraging results appeared :

Union Depot accepted elevation....................	1008′
" " by levels of O. C. & A. R. R.........	995′
" " " " " A. & G. W. R..........	1007′
" " " " " L. S. & M. S. R..........	1011′

The O. C. & A. R. levels appear to agree with the P. & E. and were supposed to be based on the P. R. R. datum at Philadelphia, which required an addition of 7′ to reduce it to ocean and make it conform to Lake Erie at 573′ above ocean. The A. & G. W. and L. S. & M. S. levels came in direct from Lake Erie. There was evidently some error between Oil City and the Lake if our accepted elevation of the Union Depot was correct. We endeavored to find it by connecting together the several Depots and bench-marks obtained from the railroad profiles, at Franklin, Irvineton, Corry, Union City and Erie, but did not succeed, and finally as a last resort, re-leveled the P. & E. R. R. from Union City to its junction with the L. S. & M. S. at Erie, and to the Lake.

To our surprise, the profile of the P. & E., which had been considered unreliable, was found to be remarkably correct, except as to ocean datum. The stations checked closely in every case, except in one or two instances where no doubt there had been an alteration of track, and the difference of elevation between Union City and the crossing at Erie as given by it and as ascertained by our levels varied only 0.08′.

By connecting the P. & E. Depot at Union City with the A. & G. W. Depot at the same place it was found that these two roads gave precisely the same fall from Cory crossing to Union, so that it was not deemed necessary to re-level that part of the P. & E. Rail Road.

From the Erie crossing above mentioned, connection was made with the L. S. & M. S. Depot at Erie, and, also, a line was run direct to the Lake. The line to the Lake confirmed the elevation given by the L. S. & M. S. R. R. for the Depot at Erie. It showed about six inches less elevation, but this is probably due to full water in the lake at this season of the year.

The P. & E. levels may therefore be considered as well tested and checked from the lake to Corry crossing, and they establish the latter point as will be seen further on at 1427′ above ocean (at New York).

When we inquire into the reason why 1416′ was given on the old P. &

E. profile as the elevation of the old Corry depot, and A. & G. W. crossing, instead of 1427 as it should be; we find that the levels of this end of the road, as far east as Warren (how much farther we do not know) were run from the Lake. They were based on lake level at 565′, the accepted elevation of the lake at the date of that Survey, and were consequently 8′ too low. In addition to this there seems to have been an error in placing the old P. & E. Lake Depot 8′ above the surface of the Lake. It should have been 11′ as the levels now show. It appears quite probable that this 3′ error in starting at the lake was discovered and corrected in some of the engineers' notes, for I have a copy of the levels from Irvineton, west, procured from the Smithsonian Institution in which the Stations are all raised 3′ above Burgin's profile. This 3′ error added to the 8′ difference between former and present accepted lake level, makes the 11′ which we are obliged to add to raise the road to its proper height above the ocean and to place it in its true horizon to meet the levels brought up from Pittsburgh.

The first elevation given on the P. & E. profile as published (crossing of the L. S. & M. S. R. R.) shows very plainly that there is an error of 11′ between that point and the Lake thus:

L. S. & M. S. crossing by P. & E. profile (VIII) = 676
" " " " L. S. & M. S. profile (XI) = 687
" " " " Carll's levels to lake = 687

As the levels and checks above mentioned appear to establish the correctness of the P. & E. profile from the Erie crossing to Corry we see no reason to doubt its integrity as far as the same parties carried forward their line, which we are informed by one who assisted in the Survey, was as far as Warren. We therefore propose to raise all the stations between the Lake and Warren 11′.

We now find that the Union and Titusville or O. C. & A. R. R. R. (a) must be raised 13′ at Union City above the published levels to lift it to the P. & E. at that place, and 13′ also at the other end at Irvineton to make it coincide there with the P. & E. This brings Oil City up also and makes it agree (995′ + 13′ = 1008′) with our accepted elevation, as will be shown further on.

Another interesting fact is brought to light by this discussion. The levels of the O. C. & A. R. R. were run from a datum given in the field book as "Elevation of track on bridge east of Irvineton Station on P. & E. R. R. above tide water at west end of Market Street bridge at Philadelphia = 1160."

This is, no doubt, the point given by Burgin as "Irvine 1162" and it explains why (having started 2′ too low) the O. C. & A. R. R. requires to be raised 13′, while the P. & E. is only raised 11′. It also shows that the O. C. & A. R. R. datum was not the P. R. R. datum as supposed, but ocean datum, based on Lake Erie at 565′, subject to the same error of 11′ as the P. & E. with the additional 2′ made in the starting point at the bridge.

(a) The U. & T. is now a branch of the O. C. & A. R. R. R.

The two tables of the P. & E. levels (the Company's and Burgin's) given by Mr. Allen, in his R. R. levels of Pennsylvania, contain in themselves the evidences of inaccuracy. The Company's profile datum is "Mid tide Baltimore." Burgin's is P. R. R. datum on the east end and Lake Erie based on ocean on the west end (but now shown to be 11′ too low), yet both profiles give the same elevation at Corry crossing and I believe run exactly together from Corry to the lake, if they could be compared at precisely the same points. They seem both to have been made from one line of levels. Where the error in joining the line run from the east with the line run from the west may have occurred we do not know,* but certain it is that no "P. R. R. datum" or "mid tide Baltimore datum" levels have been correctly brought through to Irvineton.

Mr. Gardner in his discussion of R. R. levels to establish the surface elevation of Lake Erie, says, Lake Erie is above Harrisburg by P. & E. levels 251′; this added to the height of Harrisburg, 319.75′ = Lake Erie 570.75′. If the levels of this road were run from Harrisburg west, and from the Lake east, it is perceived at once that the P. & E. levels had nothing whatever to do with the difference of elevation between Harrisburg and the Lake. It was only the difference between 314′, the starting point at Harrisburg as given by Burgin and 565′ the starting point at Erie. The Harrisburg end was raised 5.75′ to bring it up to correct ocean level, the Lake end 8′ to bring it up to accepted lake level, consequently the line showed an error of 2.25 making Lake Erie, 570.75′ instead of 573′. Of course it was supposed that the levels were corrected throughout, but they could not have been correctly connected in fact, for we shall show that while the western end requires to be lifted 11′ the centre needs to be raised from 19′ to 23′.

We have met this same trouble in other roads in this district, where they have been run from one known, or supposed to be known, elevation to another. They agree at each end with the points given, but our cross checks lead to the suspicion that it has required some adjustment and alteration of the levels actually obtained to make them do so.

The re-leveling of the P. & E. R. R. and the corroborative circumstances above given should establish the correctness of our Union City adopted elevation of 1270′ and our Corry adopted elevation of 1427′ at the crossing of the P. & E. and A. & G. W. Railways almost beyond a question. They cannot vary more than the fraction of a foot from the figures here given. They also furnish the data from which to adjust the levels of the O. C. & A. R. and Union & Titusville Railways leading from the P. & E. to Oil City as will be seen below.

Absolute accuracy is not of course to be expected in an adjustment of this kind, where the levels of different roads are to be tied together and compared. Slight errors necessarily creep into every profile—by the change in engineers employed ; and consequent mistakes in benches and level points, which often are not plainly marked or described in the notes as they should be ; by local alterations of track or change in position of depots not always carefully noted ; by alterations at junctions and crossings made by one road and not recorded by the other ; and by clerical errors in copying and working up the notes and profiles.

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* It seems quite probable, we think, that the error will be found between West Creek Summit near St. Mary's and Clarion Summit near Kane. In that case West Creek Summit should be raised 19′ to correspond with Emporium, and all stations between Kane and Warren 11′ to correspond with the Lake end of the line.

In making these adjustments considerable time has been spent in the field in ascertaining the relation levels of depots, crossings, benches &c. At Pittsburgh, Allegheny City, Freeport, Parker's, Franklin, Oil City, Irvineton, Titusville, Corry, Union City, Erie City, Girard and other places, and in every case more or less variation has been found, relatively, in the points given—comparing them as they now are and as they were when originally established. These sources of error cannot now be eliminated without a careful re-leveling of the railway lines, which manifestly is an impossibility under the circumstances. It only ramains for us to make the best practical use we can of the materials at command. As we have shown that they are somewhat defective it would be folly to pretend to work out these hypsometric elevations to the decimal part of a foot. We shall not attempt it but aim only to establish the levels of some of the more important points in this district within a foot or two of the truth which is near enough for all practical purposes.

A

The first line considered will be from Pittsburgh to Lake Erie by the Allegheny Valley, Bennett's Branch, Philadelphia & Erie, and Buffalo, N. Y & Erie Railways.

			Above ocean.
Pittsburg U. Depot		Accepted elevation	745
Red Bank Junct	106	Above Pittsburgh by A. V. profile (I)	851
“ “	832	“ ocean by Bennett's Branch “ (IV)	
“ “	19	Too low on “ “ “	
Driftwood Junc.	37	Below Red bank Junct. by B. Branch profile (IV)	814
“ “	795	Above ocean by P. & E. profile (Note to IV)	
“ “	19	Too low on P. & E. profile	
Emporium Junc	208	Above Driftwood Junc. by P. & E. profile (Allen CCXV)	1022
“ “	1003	Above ocean by P. & E. profile (do.)	
“ “	1021	“ “ B.N.Y. & P. “ (XVII)	
“ “	19	Too Low on P. & E. “	
“ “	1	“ “ B. N. Y. & P,	
Olean Crossing	414	Above Emp. Junct. by B. N. Y. & P. profile (XVII)	1436
“ “	1438	Above ocean by N. Y. & Erie profile (Jersey City datum)	
“ “	1435	Above ocean by B. N. Y. & P. “	
“ “	2	Too high on N. Y. & Erie “	
“ ‘	1	“ low “	
Lake Erie	862	Below Olean Crossing by B. N. Y. & P. profile (XVII)	
“ “	864	Below Olean Crossing by N. Y. & Erie profile (XVIII)	
“ “	863	Below Olean—mean of the above levels	573

This line it will be noted lifts all the levels from Red Bank Junction to

Emporium Junction 19 feet, and the B. N. Y. & Philadelphia levels 1′ as far as Olean. It crosses the N. Y. & Erie Railway at Olean two feet below the Erie levels, which were run from tide at Jersey City and would reach the Lake one foot too high if carried down by the B. N. Y. & Philadelphia levels, which gives 862′ fall. But we find that the N. Y. & Erie levels give 864′ fall so that a mean between the two, 863′ subtracted from 1436′ = 573′ the precise elevation as accepted for Lake Erie. The B. N. Y. & Philadelphia levels are said to have been run from the water of Buffalo Creek some distance from the lake and may therefore be presumed to be based on a higher point than lake level.

Variations of from one to three feet will be found between different lines at nearly every point we are attempting to compare. As we are only rising even feet in making this adjustment, a disagreement of one foot may sometimes occur in this way between two roads where there would really be but a very slight difference if the decimals were accurately taken into account.

B.

Pittsburgh to Lake Erie by the Allegheny Valley, Oil Creek, and Allegheny River, Union and Titusville and Philadelphia and Erie Railways.

			Above ocean.
Pittsburgh		Accepted elevation	745
Oil City U. Depot	263	Above Pittsburgh by A. Valley profile (I)	1008
“ “	995	Above ocean by O. C. & A. R. profile (VI)	
“ “	1007	Above ocean by A. & G. W. profile (X)	
“ “	1011	“ “ “ L. S. & M. S. “ (XII)	
“ “	13	Too low on O. C. & A. R. profile	
“ “	1	“ “ A. & G. W. “	
“ “	3	Too high on L. S. & M. S. “	
Titusville	186	Above Oil City by O. C. & A. R. profile (VI)	1194
“	1181	Above ocean by O. C. & A. R. profile (VI).	
“	1181	Above ocean by U. & T. profile (VII) .	
“	13	Too low on O. C. & A. R. “	
“	13	“ “ U. & T. “	
Union City P. & E. Depot . .		Accepted elevation established by levels from the lake	1270
“ “ “ . .	177	Above Titusville by U. & T. profile (VII). . . . . (1271)	
“ “ “ . .	1258	Above ocean by U. & T. profile (VII).	
“ “ “ . .	1259	“ “ P. & E. “ (VIII).	
“ “ “ . .	12	Too low on U. & T. “	
“ “ “ . .	11	“ “ P. & E. “	
Erie City L. S. & M. S. & P. & E. Cross’g.	583	Below Union City by P. & E. profile (VIII)	687
“ “ “ “	583	Below Union City by levels run by J. H. Carll	687
“ “ “ “	676	Above ocean by P. & E, profile (VIII).	
“ “ “ “	11	Too low on “ “	
Erie City L. S. & M. S. Depot	0.72	Below Erie Crossing (Carll’s levels) . .	686
“ “		Above ocean by L. S. & M. S. profile (XI)	686
“ “	113	Above lake by L. S. & M. S. profile (XI)	
“ “	113	“ “ “ Carll’s levels	
Lake Erie		As above 686–113	573

This determination shows a very satisfactory line of levels from Pittsburgh to the Lake by raising the O. C. & A. R. and Union & Titusville Railways 13 feet and the P. & E. Railway 11 feet and by throwing off all the decimals on the Allegheny slope and making the most of them on the Lake slope. But even by doing this there is still an error of one foot to be accounted for at Union City which is referred to more fully in remarks following determination C.

Mr. Gardner in summing up his conclusions on the elevation of Pittsburgh says he is inclined to accept 746 in preference to 745 for the elevation of the Union Depot. But the levels of the Railroads leading to the Lake through this district conform better to the height we have adopted, 745, and might even seem to suggest a lower level for Pittsburgh.

C.

Oil City to Lake Erie, by the Oil Creek and Allegheny River Railway to Irvineton and the P. & E. Railway from Irvineton to the Lake—using Burgin's profile of the P. & E. Railway.

			Above ocean.
Oil City		Accepted elevation	1008
Irvineton Bridge. . .	165	Above Oil City by O. C. & A. R. profile (VI) . . .	1173
“ “ . . .	1162	“ ocean by P. & E. “ (VIII). . .	
“ “ . . .	1160	“ “ “ O. C. & A. R. “ (VI) . . .	
“ “ . . .	11	Too low on P. & E, “	
“ “ . . .	13	“ “ O. C. & A. R. “	
Corry Crossing A. & G. W. & P. & E.	254	Above Irvineton by P. & E. profile (VIII). .	1427
“ “	1416	“ ocean “ “ “ “ . .	
“ “	1429	“ “ “ A. & G. W. “ (IX). . . .	
“ “	1418	“ “ “ O. C. & A. R. “ (VI). . . .	
“ “	11	Too low on P. & E. “	
“ “	9	“ “ O. C. & A. R. “	
“ “	2	Too high on A. & G. W. “	
A. & G. W. Depot Union City	128	Below Corry by A. & G. W. profile (IX)	1299
“ “	1301	Above ocean “ “ “ “	
“ “	2	Too high on “ “	
P. & E. Depot Union City	29.22	Below A. & W. Depot, Union City (Carll)	1270
“ “	157	“ Corry crossing by P. & E. profile (VIII). .	1270
“ “	1259	Above ocean “ “ “	
“ “	11	Too low on “ “ “	
L. S. & M. S. & P. & E. Erie Crossing.	583	Below Union City by P. & E. profile (VIII) . . .	687
“ “	583	“ “ “ “ Carll's levels	687
“ “	114	Above Lake Erie by L. S. & M. S. profile & Carll (XI)	687
“ “	·676	Above ocean by P. & E. profile	
“ “	11	Two low on “ “	
Lake Erie.	114	Below P. & E. & L. S. & M. S. crossing as above.	573

The levels of the Dunkirk Allegheny Valley and Pittsburgh R. R. touching the P. & E. at Irvineton, are so widely astray and evidently unreliable as heretofore published that we can make no use of them in this connection to reach the Lake. A trip to Dunkirk expressly for the purpose of examining the profiles with a view of including the levels of the road in this discussion resulted unsuccessfully, for the want of a permit from headquarters in New York and we are obliged to omit them altogether.

So too, unfortunately with the Buffalo Corry & Pittsburgh Railway crossing the P. & E. at Corry, which would have given another link to the Lake at Brocton. The published levels are so vague and uncertain that we must omit them also. Mr. Ashmead kindly permitted and assisted in a thorough search among the papers in his office at Oil City, but no profile or connected notes of the levels could be found.

If our accepted elevations of Irvineton, Corry, and Union City are correct, and we have every reason to believe that they are, it appears quite evident that there must be some mistake in the levels of the O. C. & A. R. and U. & T. Railways, otherwise they would agree with our accepted elevations if raised uniformly 13′ at all points, instead of 13′ at Irvineton, 9′ at Corry and 12′ at Union City. They start as we have shown at an elevation of 1160′ at Irvineton, which represents 1162′ on the P. & E. profile, and running around by Oil City and Titusville reach Union City at 1257′ which should represent 1259′ on the P. & E. profile if all the levels were harmonious. From the published tables it would be inferred that the P. & E. Depot in the U. & T. tables was the same as the P. & E. depot in the P. & E. tables; but the U. & T. profile shows that the point 1257′ was the junction with the P. & E. and this junction is 1.39′ lower than the depot. There is therefore a disagreement of one foot or more between the two lines of levels from Irvineton to Union City, the P. & E. being about 34 miles in length and the O. C. & A. R. and U. & T. about 92 miles. This is not sufficient to cast doubt upon the main line of levels and we therefore accept them as correct as far as Tryonville Junction, presuming that the error lies somewhere quite near Union City, for we find our levels there between the crossings and Depots to differ quite materially from those given by the U. & T. profile as will be seen by reference to Union City levels.

We now have these three points apparently well established.

Tryonville Junction	1320′
Corry	1427′
Union City	1270′

Tryonville Junction is 111′ below Corry by O. C. & A. R. (VI).
" " 49′ above Union City by U. & T. (VII).

Then calculating the elevation of Tryonville J. from Corry and Union City we have:

Tryonville by O. C. & A. R. levels $1427 - 111 = 1316$
" by U. & T. " $1270 + 49 = 1319$

The relative elevations of Corry and Union City are well assured by the exact agreement of the P. & E. and A. & G. W. levels between those places, and we therefore can only conclude that there is an error of one foot to be accounted for on the U. & T. profile between Tryonville Junct. and Union City, and an error of 4′ on the O. C. & A. R. profile between Tryonville and Corry which we have been unable to place and must, therefore, leave for future adjustment.

D

Oil City to Ashtabula by Franklin Branch of Lake Shore and Michigan Southern Railway.

			Above ocean.
Oil City,		Accepted elevation	1008
Stoneboro' . . .	160	Above Oil City by L. S. & M. S. profile (XII)	1168
“ . . .	1171	“ ocean “ “ “ (XII)	
“ . . .	1171	“ “ by N. C. & F. “ (XIV)	
“ . . .	3	Too high on L. S. & M. S. “	
“ . . .	3	“ N. C. & F. “	
Salem Crossing.	184	Below Stoneboro' by L. S. & M. S. profile (XII). . . .	984
“ “	987	Above ocean “ “ “ (XII) . . .	
“ “	982	“ “ by A. & G. W. “ (IX) . . .	
“ “	3	Too high on L. S. & M. S. “ . . .	
“ “	2	“ low “ A. & G W. “ . . .	
Jamestown . . .	3	Above Salem Crossing by L. S. & M. S. profile (XII).	987
“ . . .	990	“ ocean “ “ “ (XII).	
“ . . .	979	“ “ E. & P. “ (XIII)	
“ . . .	3	Too high on L. S. & M. S. “ . .	
“ . . .	8	“ low “ E. & P. “ (a) . .	
Ashtabula . . .	342	Below Jamestown by L. S. & M. S. profile (XII) . . .	645
“ . . .	648	Above ocean “ “ “ “ . . .	
“ . . .	3	Too high on “ “ “ (b) . . .	

(a) The two depots here are not on precisely the same level, but there certainly cannot be 11′ difference in their elevations. The E. & P. appears to be wrong wherever we check it.

(b) These levels, according to profile, run into Ashtabula at the proper elevation (74.52) to agree with the levels of the main line which are accepted as correct. But it is hard to explain why the Franklin Branch overruns the A. & G. W. at Salem Crossing, at Franklin, at Reno, and at Oil City, while the same levels of the L. S. & M. S., taken at Erie Crossing and Carried to Union City by the P. & E. Railway, run under the A. & G. W. at that place. The P. & E. levels from Erie to Union City were re-run but no error could be discovered there. We have no ground for charging the whole mistake to the A. & G. W., for their levels, as will be seen in another place, bear every evidence of more than ordinary precision from Salamanca to Dayton. It would appear as if the Franklin Branch of the L. S. & M. S. had been started from a higher point than that given on the main line as 74.52. But this, of course, is an inference only and may be entirely wrong.

E

From Pittsburgh to Stoneboro' by Pittsburgh, Fort Wayne and Chicago to Homewood, New Castle and Beaver Valley to New Castle and Franklin to Stoneboro'..

			Above ocean.
Pittsburgh.		Accepted elevation	745
Homewood.	204	Above Pittsburgh by P. F. W. & C. profile (XVI)	949
New Castle.	147	Below Homewood by N. C. & B. V. “ (XV).	802
“ “	809	Above ocean by E. & P. “ (XIII) (a) . . .	
“ “	7	Too high on “ “	
Stoneboro'.	368	Above N. Castle by N. C. & F. profile (XIV)	1170
“ .	160	“ O. City by L. S. & M. S. profile (XII) accepted (b)..	1168
“ .	1171	“ ocean “ “ “ “	
“ .	1171	“ “ N. C. & F. “ (XIV)	
“ .	2	Too high by levels brought from Pittsburgh	
“ .	3	“ on L. S. & M. S. profile	
“ .	3	“ “ N. C. & F. “	

(a) It is supposed that the elevation here given by the E. & P. refers to a point somewhat higher than the present Depot.

(b) We prefer to accept 1168′ as the elevation of Stoneboro' instead of 1170′ or 1171′ for several reasons. From Pittsburgh to Oil City by the line just followed we find a rise of 265′, while from Pittsburgh direct to Oil City by the A. Valley Railway levels well tested we have a rise of 263′. There is an error of 2′ somewhere in the circuit. The L. S. & M. S. levels are too high at Oil City when compared with the A V., the O. C. & A. R. and the A. & G. W.; they are too high again at Franklin, compared with the A. V. and A. & G. W.; too high at Salem Crossing, compared with the A. & G. W.; and too high at Jamestown, compared with the E. & P. We are not certain that the connecting link between N. Castle and Stoneboro' shows precisely the difference in elevation between the Depot of the N. C. & B. V. at N. Castle and the Depot of the L. S. & M. S. at Stoneboro. There might easily be a difference of two feet between the Depots of the N. C. & F. and those of the other roads named. Our accepted level at Oil City appears to be a mean between the highest and lowest levels given wherever a check can be secured, and it therefore seems safe to adhere to it.

F

Review of the levels of the Atlantic and Great Western Railway.

			Above ocean.
Salamanca . .	1393	Above ocean by A. & G. W. profile (IX)	
. .		Point given as centre of Hemlock st.	
" . .	1384	Above ocean by N. Y. & Erie profile (XVIII)	
. .		Supposed to be the old Depot	
Present Depot.	1.3	Lower than Hemlock St. (Carll)	
Old Depot. . . .	14.2	" " " " "	
Present Depot.	1392	Above ocean by A. & G. W. levels (1393–1)	
" "	1397	" " N. Y. & Erie " (1384–13)	
" "		Accepted elevation.	1393

The N. Y. & Erie, as before stated, reaches the Lake 2′ too high, so that there appears to be but 3′ disagreement between the levels of the A & G. W. and the N. Y. and Erie, if we have taken our points correctly, and 1393′ will be a fair mean between the two for the present depot.

Levant, Accepted elevation as given by A. & G. W. (IX) 1267

The D. A. V. & P. Ry. coming up from the lake at Dunkirk crosses the A. & G. W. here. The elevation given by it is 1262 (Allen CCCVI), but it does not appear to be reliable.

Corry, A. & G. W. 2′ too high as shown in C.

Union City, A. & G. W. 2′ too high as shown in C.

Salem Crossing, A. & G. W. 2′ too low as shown in D.

			Above ocean.
Clarkesville Crossing	46	Below Salem Crossing (D) = 984–46.	938
" "	936	Above ocean by A. & G. W. profile (IX)	
" "	930	" " E. & P. " (XIII) . . .	
" "	2	Too low on A. & G. W. " . . .	
" "	8	" " E. & P. " . . .	

At Jamestown the E. & P. was 8′ too low (D) by our accepted elevation and 11′ too low by L. S. & M. S. levels, and here we find it 8′ too low by our adjustment, and 6′ if the A. & G. W. is correct—while at N. Castle (E) it is 7′ too high. In the first and last places the difference may be in a measure due to a want of unity in the points given by the several roads, but until we have more positive information on these points the E. & P. levels must be regarded as very unreliable.

Further Checks on the A. & G. W. Railway, in Ohio:

			Above ocean.
Ravenna Cross'g.	522	Above Lake Erie by A. & G. W. profile (See Ohio. Geological Report, Vol. I, p. 667).	1095
" "	519	Above Lake Erie by Cleveland & Pittsburgh profile (Authority J. Linton, Chief Engineer).	1092
	3	Disagreement.	
Newburg Cross'g.	175	Above Lake Erie by A. & G. W. profile (IX).	748
" "	174	" " " C. & P. " (Linton).	747
	1	Disagreement.	
Gallion.	596	Above Lake Erie by A. & G.W. profile (O.R. I, p.667).	1169
"	595	" " " C.C.C. & I. " (O.R. I, p.668).	1168
	1	Disagreement.	
Urbana.	454	Above Lake Erie by A. & G.W. profile (O.R. I, p.667).	1027
"	458	" " " S.D. & C. " (O.R. I, p.671).	1031
	4	Disagreement, relative levels of depots unknown	
Dayton.	179	Above Lake Erie by A.& G. W. profile (O.R. I, p.667).	752
"	180	" " " D. & M. " (O.R. I, p.671).	753
	1	Disagreement.	

The Dayton & Michigan Railroad check is used by Mr. Gardner (page 644) and accepted as reliable.

G.

East end of the Philadelphia and Erie Railway, compared with the Northern Central.

			Above ocean.
P. R. R. Datum.			6.913
Harrisburg.	313	Above P. R. R. datum by P. R. R. profile (Allen I).	320
Bridgeport Cros'g	29	Above Harrisburg by P. R. R. profile (Allen I).	349
" "	30.25	" " by N. C. profile (Gardner, pp. 635).	350
Sunbury.		Above Ocean by N. C. profile (Allen CC.).	444
"	428	" " P. & E. " (Allen CCXV).	
"	430	" " Burgin's " " "	
	16	Too low on P. & E. profile.	
	14	" " Burgin's "	
W'msport Junct.		Above Ocean by N. C. profile (Allen (CCXVII).	540
" "	516	" " P. & E. " (Allen CCXV).	
" "	24	Too low on P. & E. profile.	
" Depot	5.59	Below Junction by P. & E. profile (Allen CCXV).	
		On Northern Central bases (540–6).	534
" "	510	Above ocean by P.& E. profile (Allen CCXV).	
" "	513	" " by Burgin's " " "	
" "	24	Too low on P. & E. profile.	
" "	21	" " Burgin's "	
Elmira.		By N. C. profile (Allen CCXVII).	865
"		By N. Y. & E. profile (Allen CLXII).	863

This last check makes the Northern Central levels appear good. The levels of the N. Y. and Erie Railway have been brought up from Jersey City, about 273 miles, and those of the Northern Central from Baltimore, 256 miles showing a disagreement of only two feet at Elmira. It seems quite safe, therefore to assume that the P. & E. elevations of Sunbury and Williamsport are altogether too low, as they have likewise been shown to be at Driftwood, Emporium, Irvineton, Corry, Union City and Erie.

CONTRIBUTIONS FROM THE LABORATORY OF THE UNIVERSITY OF PENNSYLVANIA.

No. IX.

Upon some new Chlorine Derivatives from Toluol.

By Edgar F. Smith, Ph.D.,

Assistant in Analytical Chemistry, University of Pennsylvania.

(*Read before the American Philosophical Society, May* 4, 1877.)

The first of these derivatives which it is my intention to describe in the following lines was obtained by me some time ago, and also a description of it published (Inaugural Dissertation, Göttingen, 1876), but as it is intimately connected with the subsequent work a brief description of its production and properties may probably not be amiss.

PRODUCTION OF TOLUOLTRICHLORIDE OR BENZYLTRICHLORIDE.

This was obtained in the usual manner, viz.: By the introduction of a calculated amount of dry chlorine into boiling Toluol. The liquid boiling at 218° C. was collected and treated as follows :

FORMATION OF $C_{21}\ Cl_{26}$.

The pure Benzyltrichloride was placed in a large flask and dried chlorine gas conducted into the liquid until it was no longer absorbed and the vacant space also filled with it, when the flask was tightly corked and exposed to the action of the sun-light. After standing a few days the green color of the chlorine had disappeared. The flask was again filled with the gas and this operation repeated, until the chlorine was apparently no longer absorbed. The flask was now set in a rather cool place and allowed to remain there for some time. After standing several months I noticed that crystals had separated from the liquid. These were immediately brought upon a filter, washed thoroughly with water and then pressed between filter paper to remove any Benzyltrichloride that may have adhered to the crystal mass. After drying the compound by exposure to the air, it was pulverized and dissolved in chloroform, from which solution it crystallized in fine, colorless crystals, which after repeated re-crystallization fused at 152°–153° C.

Properties.—The compound possesses an odor very similar to that of camphor, is insoluble in water and alcohol, but readily soluble in chloroform. It is volatile without decomposition. My attempts to affect the introduction of the NO_2 group were unsuccessful. Even with the aid of heat nitric acid is without any action.

If the compound is allowed to crystallize slowly from a chloroform solution, crystals may be obtained half an inch long and one-fourth of an inch broad. These have prism and dome faces.

I never succeeded in obtaining the compound during summer, very probably because the Benzyltrichloride held it in solution.

Numerous analyses made of the compound lead to the following formula : $C_{21}\ Cl_{26} = (C_6\ Cl_6\ C\ Cl_3).\ (C_6\ Cl_5\ C\ Cl_3).\ (C_6\ Cl_6\ C\ Cl_3)$.

We have here, then, a compound in which three benzol groups have very probably combined, containing only carbon and chlorine.

ANALYSES.

Chlorine Determinations.

I. The compound was dried over sulphuric acid and burned with oxide of lime, and the calcium chloride which was produced dissolved in nitric acid and the chlorine precipitated with silver nitrate.

0.2181 Grm. substance gave .6928 Grm. silver chloride, corresponding to 78.53% chlorine.

II. .1035 Grm. substance gave .329 Grm. silver chloride = 78.58% chlorine.

III. 0.0868 Grm. substance gave .2765 Grm. AgCl = 78.57 % chlorine.

IV. Finally, I fused a portion of the compound on a watch glass and then heated it with oxide of lime.

.0893 Grm. sub. gave .2843 Grm. silver chloride = 78.75% chlorine.

Carbon Determinations.

I. .3629 Grm. substance dried at 75°C. and then burned with coarse lead chromate, yielded .0780 Grm. CO_2 = 21.41% carbon.

Not any water was noticed in the calcium chloride tube and its weight had not increased.

II. .2513 Grm. dried substance, burnt with lead chromate gave .0536 Grm. CO_2 = 21.33% carbon.

III. .1677 Grm. well dried substance gave .0361 Grm. CO_2 = 21.51% carbon.

Several more combustions were made with about the same result. In no instance did the found percentage of water exceed 0.40%. This amount of moisture could have readily collected during the filling of the combustion tube.

RESULTS.

Calculated.	Found.
$C_{21} = 252 = 21.44\%$	21.41 — 21.33 — 21.51
$Cl_{26} = 923 = 78.56\%$	78.57 — 78.58 — 78.53 — 78.75.

ACTION OF ZINC AND SULPHURIC ACID UPON $C_{21}Cl_{26}$.

About five grammes of the preceding compound were pulverized and dissolved in a mixture of alcohol and chloroform, and zinc and sulphuric acid added to this solution. The liberation of hydrogen gas was rather slow and to hasten it the flask containing the mixture was placed on a sand-bath, where a constant temperature of 60°C. was maintained for ten weeks, during which period there was a constant and brisk disengagement of hydrogen gas. The flask was now placed upon a water-bath and the alcohol and chloroform removed by distillation. An impure oil remained as a residue and upon cooling solidified and was then taken from the flask and dissolved in a mixture of chloroform and alcohol. After removing the impurities by filtration, the solution was strongly evaporated and when cool the compound separated partly as an oil and partly in colorless tablets.

After pouring off the supernatant liquid the crystalline mass was pressed well between filter paper and then dissolved in alcohol. From this solution the compound crystallized in beautiful, colorless, quadratic plates, which after several recrystallizations fused at 102° C.

Properties. If a crystal is fused upon a piece of glass it will remain in a plastic condition for hours and stirring it with the point of a knife blade will not cause solidification. One crystal which I fused required twelve hours before becoming solid. The fusing point of this solidified mass was the same as that of the crystals, 102° C.

The compound may be volatilized without suffering decomposition. When pure it possesses a very peculiar, aromatic odor, somewhat like that of the preceding compound, being only more piercing.

The compound is perfectly insoluble in water, but very readily soluble in chloroform. The best solvent I found to be alcohol, in which, when warm, it is exceedingly soluble.

The following analyses were made :

Chlorine Determination.

0.4180 Grm. substance dried over calcium chloride and burned with oxide of lime gave 1.3146 Grm. silver chloride = .3252 Grm. chlorine = 77.79% chlorine.

Carbon Determination.

.3812 Grm. air dried substance burned with lead chromate, gave 21.69% carbon and 1.00% hydrogen.

If we suppose that only one hydrogen atom has replaced chlorine, the following numbers would be required :

Calculated.	Found.
$C_{21} = 22.09\%$	21.69%
$Cl_{25} = 77.81\%$	77.79%
$H = 0.09\%$	1.0%

The formula would, therefore, be $C_{21}Cl_{25}H$. That the replacement would be so very limited, one would naturally suppose if he considered the presence of such a large number of negative chlorine atoms.

ACTION OF SODIUM AMALGAM UPON $C_{21}Cl_{25}H$.

The substance was finally divided and dissolved in an excess of alcohol, and sodium amalgam added to the solution. The liberation of hydrogen gas was at first very violent, finally, however, the application of heat upon a sand bath was necessary to render the disengagement continuous. After allowing the action to continue three or four days, I interrupted it and proceeded to examine the contents of the flask.

The alcohol was distilled off, and as the liquid gradually diminished in volume, drops of oil separated from it. Only a small quantity of the oil could be obtained, and after being purified, was too small to employ in an analysis, expected to afford some clue to the composition of the compound. Intense cold would not render this oil solid.

ACTION OF SODIUM AMALGAM UPON $C_{21} Cl_{26}$.

Ten grammes of the substance were reduced to a powder, placed in a small flask, and alcohol then poured in, and the whole heated upon a sand bath for four weeks. At the expiration of this time the alcoholic solution was poured off from the metallic mercury that had collected upon the bottom of the flask, and water and hydrochloric acid added to the solution to dilute it and neutralize any sodium carbonate that may have formed.

Upon adding the water I noticed the appearance of oil globules, which swam upon the surface of the liquid.

The solution was placed in a suitable vessel and subjected to distillation upon a water bath. In the receiver a rather large quantity of oil collected. In the flask, upon examination, I found merely sodium chloride.

The further addition of water to the liquid in the receiver rendered it cloudy, and it was again distilled, but this time over a free flame. The alcohol, of course, first passed over, and the addition of water to it produced no cloudiness.

The oil was carried over with the steam and collected to one large globule on the bottom of the receiver.

Soon after all the oil had passed over, I noticed the liquid carried over small shining needles. The receiver was immediately changed and the distillation continued. Only a small quantity of this crystallized compound was caught. It was exceedingly soluble. It was extracted from its aqueous solution with ether and the latter allowed to evaporate. The residue consisted of fine colorless needles, possessing a rather sharp odor. The compound fused at about 127° C. With barium carbonate it gave a salt crystallizing in white needles. Scarcity of material prevented its analysis.

To extract the oil from the aqueous solution ether was added, and the two liquids separated with a separatory funnel. After the evaporation of the ether, the oil was treated with calcium chloride, to remove any adherent moisture and afterwards dried over sulphuric acid.

Properties. The oil is perfectly clear. Insoluble in water, but soluble in ether. It is with difficulty volatilized.

The following analyses were made :

Carbon Determination.

.1132 Grm. of the oil were placed in a small bulb tube and burned with lead chromate, yielding .1603 Grm. CO_2 = .043% Carbon = 38.60% : further, .0500 water = .0056 H = 4.94% H.

Upon examining the bulb tube after the combustion, a small quantity of undecomposed carbon was noticed.

Chlorine Determination.

.0463 Grm. oil ignited with oxide of lime gave .0980 Grm. silver chloride — 52.33 % chlorine.

RESULT.

C = 38.60%
Cl = 52.33%
H = 4.94%

Synopsis of the Cold Blooded Vertebrata, procured by Prof. James Orton during his Exploration of Peru in 1876–77.

' BY E. D. COPE.

(*Read before the American Philosophical Society May* 4, 1877.)

REPTILIA.

OPHIDIA.

1. **BOTHROPS PICTUS** Tsch. Jan. Elenco Sistematico, p. 126. *Lachesis pictus*, Tschudi Fauna Peruana, p. 61, Tab. X.

Nos. 11, 14, 15, 17, 19, from Chimbote Valley, Lat. 9° S., altitude from 0 to 2000 feet.

A very distinct species, well figured by Tschudi. In five specimens the fossa is bounded in front by the second superior labial plate, as described by Jan; in one other the fossa is surrounded by small scutella.

2. **ELAPS CIRCINALIS** Dum. Bibr. VII, p. 1210. Cope, Journal Academy Nat. Sciences, 1865, p. 182.

No. 45, Pacasmayo.

3. **ELAPS TSCHUDII** Jan. Revue et Magazine de Zoölogie, 1859, Prodrome d'une Iconographie, etc., p. 13.

No. 18, Chimbote Valley.

4. **OXYRRHOPUS FITZINGERII** Tschudi, Fauna Peruana Reptilia p. 56. Tab.

No. 21, Chimbote Valley.

5. **OXYRRHOPUS CLELIA** Dandin. Dum. Bibron VII p. 1007.

6. **SIBON ANNULATUM** Linn. *Dipsas* Dum. Bibr. VII, p. 1141. *Leptodira* Günther.

Nos. 23–25, Chimbote Valley.

7. **TACHYMENIS PERUVIANA** Wiegmann "1834" (fide Peters); Archiv. für Naturgesch. 1845, 165.

No 72, from Cuzco; elevation 11000 feet.

This species is probably distinct from the *T. chilensis* Schleg. This conclusion is derived from an examination of Wiegmann's type in the Museum of the University of Berlin, and it is sustained by the present specimen from Cuzco. Its characters are: one preocular, eight superior labials, loreal higher than long, superior surfaces of the body and tail with four series of dark spots. The characters of the *T. chilensis* are: two or three preoculars, seven superior labials, length of the loreal equaling or exceeding the height, superior surfaces with four longitudinal brown bands.

8. **DRYOPHYLAX VITELLINUS** sp. nov.

Form moderately slender, head oval, narrowed to the rather depressed muzzle. Scales smooth, in nineteen longitudinal rows, with single apical fossæ. Eight superior labials, fourth and fifth entering the orbit. Rosral small, as high as wide, just visible from above. Nasals depressed, loreal a little longer than high; oculars 1–2, the anterior impressed, nearly reaching the frontal. Temporals 1–1–2. Internasals longer than wide; prefrontals subquadrate. Frontal long and narrow, not angulate posteriorly; parietals notched behind, short, their common suture a little more than half the length of the frontal. Ten inferior labials, six of which are in contact with the geneials, of which the posterior pair is a little longer than the anterior. Gastrosteges 202; anal double; urosteges 93.

Color yellow, strongly tinged with brown above, and with orange on the labial plates and lower surfaces.

No. 3, from Pacasmayo.

This beautiful species presents a new type of color for the genus.

9. **DRYOPHYLAX ELEGANS** Tsch. *Lygophis elegans* Tsch., Fauna Peruana, p. 53, Pl. VI. *Lygophis pœcilostomus* Cope, Journ. Acad. Phila. 1875, 180.

This species was described from a young individual. Examination of several adult specimens from Prof. Orton's collection shows that the last maxillary tooth is grooved, though not deeply, and that the scales have a single apical fossa. The coloration is more striking in the adult than in the young, and is quite elegant. The ground is a light yellowish gray, and there are two rows of bright rufous darker edged spots on the back. These spots are either confluent transversely, forming a single row of broad spots, or alternating, so as to form a zigzag band. The latter condition prevails on the posterior part of the body, and the band becomes regular on the entire middle line of the tail. There are three longitudinal dark gray lines on each side, one on the middles of each of the first two rows of scales, and one on the ends of the gastrosteges. These become more or less fused on the tail, forming a single lateral band. A broad brown band from the muzzle through the eye to the first dorsal spot. Lips, gular region, and anterior gastrosteges, brown speckled; a longitudinal median nuchal band. Frontal plate dusky, with a median longitudinal light band. Length of the longest specimem M. .901; tail .280.

Nos. 12, 16, 26, 27, Chimbote Valley.

This species is the type of the genus *Lygophis* Fitz. where first characterized; *i. e.* in the Fauna Peruana. It must therefore be regarded as a synonyme of *Dryophylax* Wagl. The genus to which I have given the name *Lygophis* (Proceed. Acad. Phila. 1862, p. 75, type *L. lineatus*) may then be called *Aporophis*.

10. **DRYIOPHIS ACUMINATA** Wied.; *Dryinus æneus*, Wagl. Dum. Bibr. VII, 819.

No. 10. Chimbote Valley.

11. **DRYMOBIUS HEATHII** Cope. Journ. Acad. Philada. 1875. p. 179.

This species is nearly allied to the *D. reticulatus* (*Herpetodyas*), Peters, Monatsberichte, Berlin, 1863, 285. I add to my previous description that in a large specimen, the interocular space is only .001 wider than the length of the muzzle; and that the brown band through the eye becomes obsolete. Length M. 1.150; tail .346.

The American species of *Drymobius* (Cope, Proc. Acad. Phila., 1860. 560) are the following: *D. margaritiferus*, Schl.; *D. reticulatus*, Pet.; *D. heathii*, Cope; *D. rappii*, Gthr.; *D. occipitalis*, Gthr.; *D. pulchriceps*, Cope; *D. dichrous*, Pet.; *D. boddaertii*, Seetz; *D. melanolomus*, Cope; *D. biserialis*, Gthr.; *D. bilineatus*, Jan.; *D. pulcherrimus*, Cope.

12. **Boa ortonii**, Cope, sp. nov.

This species is intermediate in character between the *Boa constrictor* and the *B. imperator*. It has the stout proportions of both species, while the squamation of the head is like that of the former, and that of the body resembles that of the latter. There are no large scuta on the loreal or orbital regions, and the scales of the head generally are characterized by their small size. The characters of the species are best brought out in a comparative table, which I give:

Sect. I. 89–95 rows of scales on the body.
Orbital ring not in contact with labials, gastrosteges 234–40; urosteges 49–56.......................................*B. constrictor.*
Sect. II. 55–69 rows of scales.
a Orbital series separated from labials by a row of scales;
No large loral plate; form stout; g. 252, u. 53; labials 19; orbital ring composed of 19 scales; 64 rows on body.......*B. ortonii.*
aa Orbital ring reaching labials.
No large loral plate; stout; u. 56; 57–62 rows on body; orbitals 13–17...*B. imperator.*
A loral plate as large as the orbit; proportions as in the last..*B. eques.*
No large loral plate; form elongate; g. 272; u. 69.....*B. diviniloqua.*

With the typical specimen I associate one from Greytown, Nicaragua, which agrees with it in the generally smaller size of the scales of the head and body than is found in the *B. imperator*, the usual Mexican species. It has 69 rows of scales; 21 labials and 17 scales in the orbital ring; gastrosteges 242.

No. 1 from Chilete, near Pacasmayo, 3000 feet above the sea. This species is dedicated to Professor James Orton, whose explorations of the western regions of South America have yielded such abundant results.

13. **Stenostoma albifrons** Wagler; var. *tessellatum*, Tsch. Fauna Peruana, p. 46.

As Jan remarks, this forms appears to be but a color variety of the *S. albifrons.*

No. 28, Chimbote Valley.

LACERTILIA.

14. **Proctotretus multiformis** Cope, Journ. Acad. Phila. 1875. p. 173.

No. 98; from La Raia or the divide which separates the waters of the Ucayali and those of Lake Titicaca; altitude 14,000 feet.

15. Proctotretus fitzingerii Dum. Bibr. IV, p. 286.

No, 138, from Juliaca, Peru ; altitude 12,550 feet. In this lizard the lateral scales are relatively smaller and smoother than in the *P. multiformis*.

16. Microlophus inguinalis Cope, Journ. Acad. Phila. 1875. p. 172.
Nos. 33–34, Chimbote Valley. 2000 feet.

17. Microlophus peruvianus Sess. *M. lessonii*, Dum. Bibr. IV, p. 336.
Nos. 31–36, Chimbote Valley. 2000 feet.

18. Phyllodactylus nigrofasciatus sp. nov.

The existence of a fourth species of this genus in Western Peru points to this region as its centre of distribution. The present one belongs to the group in which the large dermal tubercles are not prominent nor angulate, nor arranged in regular longitudinal rows. They are round, and very distinct from the small round scales between them, and not almost assimilated to them as in the *P. inæqualis* Cope. There are eight superior labials to below the pupil of the eye. The mental scutum is very large, and urceolate ; it has two lateral, and a short posterior median facet, each one corresponding to a scutum. The anterior of these is the first labial, which is about twice as large as the scutum that follows it. Behind these is a transverse row of five subround scales, of which the median is in contact with the mental. The next row embraces eight, arranged in an undulating manner. The scales diminish but slowly to the size of the gulars.

The toes are slender as in the *T. microphyllus* Cope, but the expansions are large, as in the *T. inæqualis*. When the limbs are appressed to the side, the elbow reaches the base of the toes in this species, but only to their tips in the *T. inæqualis ;* the length of the toes in *T. microphyllus* is intermediate.

The ground color is very light, brilliantly white on the inferior surfaces. Between the axilla and groin the back is crossed above by six narrow black cross-bands. These bifurcate or break up on the sides ; the axillar band breaks up on the back, and two anterior to it are represented by spots. A broad dark band passes from the nostril through the eye and breaks up on the sides of the neck. Limbs indistinctly cross-barred.

	M.
Length to meatus auditorius	.013
" " axilla	.020
" " groin	039
" " vent	.043
Width at meatus auditorius	.007
Length of fore limb	.014
" " " foot	.004
" " hind limb	.021
" " " foot	.0065

The very different arrangement of the infralabial scales and the small digital expansions with other characters of the *P. microphyllus*[*] render comparisons with it unnecessary. From the nearer *P. inæqualis*[†] it differs primarily in three features: (1) the greater relative size of the tubercles; (2) the differently arranged infralabials, and (3) in the longer digits.

No. 35, Chimbote Valley. 2000 feet.

19. PHYLLODACTYLUS REISSII Peters Monateber. Berl. Academy, 1862, 626.

No. 140, from Pacasmayo.

BATRACHIA.

ANURA.

20. NOTOTREMA MARSUPIATUM Dum. Bibr. VIII, 598, pl. 98, (*Hyla*). *Nototrema* Gthr.

Nos. 28, Chimbote Valley; 127–8, Pisac; altitude 10,500 feet.

21. CHOROPHILUS CUZCANUS sp. nov.

A species of medium size in a genus where the species are never large. Form rather robust, head wide, flat; canthus rostrales well marked but contracted. Nostrils near the end of the muzzle, which is obtusely rounded. Tympanum distinct, its diameter half that of the eye slit, which is nearly as long as the muzzle in front of it. The limbs are rather elongate, and the digital dilatations are quite small. The wrist of the extended fore limb reaches the end of the muzzle, and the elbow is slightly overlapped by the knee when both are appressed. When the hind limb is extended forwards, the heel reaches to the line of the front of the orbit. There are no tubercles on the sole, and the skin of the superior surfaces of the body is smooth, while that of the thorax and abdomen is closely areolate.

The vomerine teeth are in two full and closely approximated fasicles between the internal nares, their posterior borders projecting a little behind the posterior margins of the latter. The nareal openings are small, and about equal to the ostiapharyngea; the tongue is discoid, and is openly notched on the posterior free border, which constitutes about one-third the length of the organ.

Color of the upper surfaces dark olive; of the limbs paler; the femur uniform light olive, posteriorly. Inferior surfaces dirty white, except those of the thighs, which are pale yellow. Sides of the head to the tympanum dark, bordered above by a blackish line along the canthus rostralis, and below by a light labial border.

	M.
Length of the head and body	.0230
Length of head to posterior line of tympanum	.0075
Width " at " " "	.0093
Total length of fore limb	.0165
" " " hind "	.0375
Length of foot	.0170
Length of tarsus	.0065

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[*] Cope, Journal Academy, Phila. 1875, p. 175. [†] Loc. cit., p. 174.

This species is one of those forms which is near the boundaries of the families of *Hylidæ* and *Cystignathidæ*. It agrees with the other species of the genus to which I have referred it in essential respects; *i. e.*, in the free toes, the fronto-parietal fontanelle, and the small and separated prefrontals. The last two characters distinguish it from *Hylodes* to which it bears a superficial resemblance, as also the terminal phalanges, which lack the transverse limb of that genus. The sacral diapophyses are but little dilated. It is noteworthy that this frog is the first one which presents these characters, known from South America, all the species of *Chorophilus*, five in number, being North American.

22. CYCLORHAMPHUS ANGUSTIPES, sp. nov.

A species of medium size, remarkable for the small extent of the palmation of the toes. The muzzle is short and rounded, its profile retreating backwards to the superior, rather elevated plane. Canthus rostrales obsolete; nares one-third nearer to the border of the orbit than to that of the upper lip. The orbits look somewhat upwards and forwards, the tympanic membrane is not visible in the derm, but exists as a small vertically oval membrane whose long diameter is one-third the vertical diameter of the eye. The skin is everywhere perfectly smooth. The thumb and second finger are of equal lengths. The web of the hinder foot is deeply notched, the edge marking the middle of the first phalange of the fourth toe; that between the first, second and third toes joining the adjacent longer toe at a still lower point. The wrist of the extended fore limb exceeds the end of the muzzle, while the heel reaches to the nostril; the tibia equals the foot without the tarsus. The choanæ are larger, and the ostiapharyngea very small. The vomerine fascicles are small and close together; they fill the narrow space between the inner borders of the choanæ. The tongue is nearly round, entire, and has the posterior fourth free.

	M.
Length of head and body	.038
Length of head to posterior line of tympana	.011
Width of head at " " "	.019
Length of fore limb	.025
" " foot (greatest)	.010
" of hind limb	.061
" of hind foot	.029
" of tibia	.017

Color above, dark plumbeous; below, a light lead color.

No. 136, from Juliaca; altitude 12,550 feet.

The characters which distinguish this species from the *C. æmaricus*, are, the greater length of the limbs, the closer approximation of the choanæ; the absence of dermal margins to the toes, the absence of cuneiform tubercle, and the close union of the metatarsal bones in the sole. This arrangement gives the sole a narrow form, without the expansiveness seen in *C. æmaricus*, where the grooves between the metatarsals are distinct.

23. Cyclorhamphus æmaricus Cope. Proc. Acad. Phila. 1874, p. 125.

Nos. 48, 49, 50, from Yura, near Arequipa; altitude 8000 feet; Nos. 81–4, from Cuzco; altitude 11,000 feet. Specimens from Cuzco are darker colored than those from Yura. They are dark plumbeous with large round black spots above; the latter are lighter plumbeous with or without dark gray smaller spots. In males from the latter locality the thorax is covered with corneous asperities and there is a large shield of horn on the inner aspect of the thumb, which is covered with acute projections.

24. Cyclorhamphus pustulosus, sp. nov.

The largest species of the genus, distinguished by its large head, and the prominent tubercles of the sides and coccygeal region.

The head is wide and flat, with the loreal region and the muzzle oblique. The canthus rostrales are obsolete, and the nares, although at the end of the superior plane of the muzzle, are equidistant between the orbit and the labial border. The membranum tympani is concealed by the skin and is a vertical oval, whose long diameter is less than half that of the eye slit. The fingers and toes are elongate, especially the last or ungual phalange; the wrist reaches considerably beyond the muzzle, and the heel to the front of the orbit. The hind foot is only half webbed, and is considerably longer than the tibia. The skin is smooth, excepting on the sides between the ilia round the vent, the superior face of the tibia, and the sole of the foot. These localities are all tubercular; the limbs with small acute warts, the side with small, obtuse, and very prominent warts, and the iliac region with larger obtuse warts.

The choanæ are not very much approximated, and the vomerine patches between them are very small. The ostia pharyngea are very minute and situated well within the external borders of the mouth. The tongue is wider than long, and entire.

Color, dark lead color everywhere excepting the gular region and the tips of the lateral warts, which are dirty white. Upper regions indefinitely shaded with brown and gray.

	M.
Length of head and body	.060
" " to posterior line of tympana	.018
Width of head at " "	.024
" of sacral expanse	.012
" of interorbital space	.005
Length of fore limb	.038
" of fore foot	.016
" of hind limb	.087
" of hind foot	.042
" of hind tarsus	.010
" of tibia	.025

No. 111, from Tinta; altitude 11,400 feet.

25. **Pleurodema cinereum**, sp. nov.

Muzzle oval, vertically truncate at the end and elevated; canthus rostrales obtuse, loreal region little oblique; nares terminal. Membranum tympani distinct, round, its diameter one-third that of the eye-slit. Wrist extending to muzzle, and the heel to the middle of the orbit. Two large palmar tubercles. Cuneiform tubercles of sole prominent, not sheathed with horn, the outer solar tubercle not prominent; no proximal tarsal tubercle. Tarsus short; remainder of foot longer than tibia. Skin with low warts on all the upper surfaces of the head and body; inguinal gland moderate, oval. Posterior inferior femoral region areolate.

The vomerine teeth are in small fasiculi extending backwards from the line of the anterior margins of the choanæ. The latter are twice as large as the small ostiapharyngea. The tongue is a wide oval, has a slit-like notch behind and is one-half free.

Color above gray leaden, with indistinct darker plumbeous spots, of which the largest is between the orbits. There are three wide vertical dark gray bands at the upper lip, the last one on the tympanum, and two paler similar bands between them. Numerous black spots on the groin; a black crescent on the inguinal gland. Limbs dark cross-banded above; posterior face of femur darkly gray spotted. Lower surfaces dirty white; gular region gray dusted.

	M.
Total length of head and body	.027
Length of head to posterior line of tympana	.008
" " at " " "	.010
Width of sacral expanse	.0055
Length of fore limb	.0170
" " foot	.0070
" of hind limb	.0410
" " foot	.0180
" of tarsus	.0050
" of tibia	.0110

No. 137, from Juliaca at 12,550 feet.

26. **Bufo chilensis** Tschudi, Batr. 88. Dum. Bibr. VIII, 678. *B. spinulosus* Weigm.

Nos. 2 and 4, Pacasmayo on the coast; 47, Arequipa, 7,500 feet; 52, Chimbote Valley; 54–56 and 124–126, Urubamba, Eastern Peru, 10,000 feet; 73–9, Cuzco, 11,000 feet; 87–8, Yaurisque, East of Cuzco, on the Apurimac, 10,500 feet; 102–110, Tinta, 11,000 feet; 129–135, Juliaca, 12,550 feet.

Having arranged the above thirty-six specimens of this toad in the order of the elevation above the sea at which they were found, beginning at the coast, and rising to 12,550 feet, I have discovered no characters of surface, of color, or of any other kind which are related to the habitats. Two of the three specimens from Pacasmayo, ♂ and ♀, are twice the average size of the others; the third one is as large as the largest of the others. Several specimens have spinulose warts.

PISCES.

HYOPOMATA.

It has sometimes appeared to the writer that a modification might with advantage be introduced into the system of Fishes, as left in his synopsis of the osteology of the subject, published in the Transactions of the American Philosophical Society, 1870, p. 449, and the Proc. Amer. Ass. Adv. Science, 1871, p. 326. The sub-classes of fishes there recognized were five; viz. the *Holocephali*, the *Selachii*, the *Dipnoi*, the *Crossopterygia*, and the *Actinopteri*. As it appears that the structural differences existing between the last two divisions are not so great as those which distinguish the others, it is proposed to combine them into a single sub-class, to be called the *Operculata*. The definitions of the four sub-classes will then be as follows:

I. Suspensorium continuous with the cartilaginous cranium, with no hyomandibular nor rudimental opercular bone; no maxillary arch; pelvic bones present; axial series of fore limb shortened, the derivative radii sessile on the basal pieces; axial series of hinder limb prolonged in ♂. .... *Holocephali.*

II. Suspensorium articulated with the cranium; no maxillary arch; no opercular nor pelvic bones; bones of limb as in the last .... *Selachii.*

III. Suspensorium rudimental, articulated with cranium, supporting one or more opercular bones; cranium with superior membrane bones; no maxillary arch; a median pelvic element; the limbs supported by segmented unmodified axes.. *Dipnoi.*

IV. Hyomandibular and palatoquadrate bones articulating with cranium, supporting opercular bones; a maxillary arch; no pelvic element; axes of the limbs shortened, the derivative radii sessile on the basal pieces........................... *Hyopomata.*

The primary divisions of the *Hyopomata* are indicated by the structure of the fins, of which there are three principal modifications, as follows:

A. Derivative radii present in both limbs; in the anterior supported by an axial segment with one or more basal or derivative radii, forming a peduncle; in the hind limbs the derivative radii sessile on axial segment only............. *Crossopterygia.*

B. Derivative radii few in the fore limb, sessile on scapula; present in hind limb, and sessile on axial segment.... *Chrondostei.*

C. Derivative radii few in the fore limb, sessile on the scapula; wanting or very few and rudimental on the hind limb so that the dermal radii rest on the axial element.... *Actinopteri.*

The classification of the *Actinopteri* then continues as in the memoirs above quoted.

27. **Corvina agassizii** Steindachner Sitzungsber, K. K. Acad. Wiss. 1875 (April), p. 26.

Nos. 5 and 43, from Pacasmayo and Chimbote Bays. These specimens have an indistinct longitudinal stripe extending along each row of scales above the middle of the body ; cross-bands are not apparent. D XII-1-21; A 2-10.

28. **Blennius tetranemus**, sp. nov.

Radii ; D. XIX-13 ; P. 13 ; V. I-2 ; A. II-18 ; first dorsal fin commencing above the preopercular border, with many of the rays of subequal length, which does not exceed the distance from their bases to the pectoral fin. An open notch between the first and the more elevated second dorsal fin. In only one out of seven specimens there is a pair of curved teeth behind the premaxillaries ; none in the lower jaw. Interorbital space narrow, deeply grooved ; behind the orbits a transverse groove behind which the vertex is swollen. A slender postnareal tentacle, a long tentacle above the posterior part of the orbit deeply split into four subequal portions ; no fringes at its base nor behind the orbit.

Orbit a little more than one-fourth the length of the head ; the head three and a-half times in the length without the caudal fin ; depth four times in the same.

Color light brown, the sides marbled with darker brown ; seven quadrate brown spots on each side of the base of the dorsal fin. Sides of head speckled with dark brown ; a large brown spot behind the eye which separates two wide light bars, one of which extends downwards and backwards from the eye, and one backwards. Anal fin dusky with a light margin ; dorsal with obscure brown shades.

	M.
Total length	.073
Length to base of pectoral	.019
" " ventral	.016
" " anal	.033
Diameter of orbit	.0045
" interorbital space	.0015

From Pacasmayo Bay.

29. **Clinus microcirrhis** Cuv. Val. XI p. 384. Geog. Hist. Chile Zoöl. II p. 275. D. XXV-12 ; V. I. 3 ; A. II-22.

No. 39, from Callao Bay.

30. **Clinus fortidentatus**, sp. nov.

A shorter species than the last with the external teeth in both jaws larger.

Radii ; D. XIX-13 ; V. 15 ; V. 1-3 ; A. II-20 ; C. 1-12-1 ; the dorsal fin commencing above the preopercular border ; the pectoral reaching to the base of the anal. Dorsal spines rather short, about half as long as the soft rays. The greatest depth is opposite the base of the pectoral fin ; the front is regularly decurved to the rather compressed muzzle, where the tips are about equal. Scales in a vertical line from the vent, 19–1–35. The diameter of the eye enters the length of the head 5.4 times; the head enters the length 4.17 times; and the depth into the same 4.5 times. There is a small cirrhus at the anterior nostril; a stout short one with a fringed border projecting from below the superior posterior border of the orbit, and a dermal flap with a fringed border on each side, extending from near the middle line, along the posterior border of the skull to opposite the superior third of the orbit. The teeth in both jaws are of two kinds; the external larger in a single row, and the internal smaller, in several rows of the former are stout and compressed, and considerably exceed in size the corresponding ones of the *C. monocirrhis*. The patches of small teeth are confined to the anterior part of the lower jaw, but extend a little further posteriorly in the upper jaw. The palatine teeth are few and coarse.

	M.
Total length	.233
Length to orbit	.022
" base of pectoral fin	.073
" " anal fin	.115
" " caudal fin	.023
Depth of body at origin of anal	.050
Interorbital width	.009

The color is a light, leathery-brown, with four vertical cross bars of a darker brown, of which lateral portion projects posteriorly from the dorsal portion. In addition to these, the body and head are thickly marked with small, dark-brown spots; similar spots on the dorsal caudal and base of pectoral fins.

No. 40, Callao Bay.

31. SICYASES PYRRHOCINCLUS, sp. nov.

A small species of rather slender form. The head is one-fifth of the total length including caudal fin; the depth of the body is one-eleventh of the same The long diameter of the orbit is one-fourth that of the head, exceeds the length of the muzzle, and enters the interorbital width one and one-half times. The front is flat, and the mouth very small, with a few large tridentate incisors, and a smaller number of smaller teeth on each side of them in each jaw. The incisors are six above, subvertical, and four below, subhorizontal. Radial formula D. 5; C. 1–7–1; A. 4; V. 4; P. 20. The posterior disc margin is wide, and extends in a broad lamina, vertically behind the pectoral fin. Pectorals and ventrals connected by membrane. Suctorial disc 5.6 times in total length; its anterior free margin narrow.

Measurements.	M.
Total length	.034
Length to anterior margin of disc	.0045
" " anus	.016
" " dorsal fin	.020
" " anal "	.021
" " caudal "	.028

The dorsal region is crossed by five wide brown spots, the anterior between the bases of the pectoral fins, those following becoming successively nearer together. They are all joined together on the sides by a brown border which presents processes downwards so as to be scolloped. Below this the surface is white. The dorsal spaces enclosed between the spots, together with the top and sides of the head are marked with a crimson network. Two chain-like bands on the operculum, and two on the base of the pectoral fin.

The precise locality from which this species was obtained, has not been preserved.

32. ATHERINA LATICLAVIA Cuv. Vol. X, p. 473.

No. 41, Callao Bay.

33. BELONE ? TRUNCATA Les. Gunther Catal. Fishes Brit. Mus. VI. p. 224.

Differs from Atlantic specimens in having the tail evenly though slightly emarginated. Radii; D. 14; A. 17. No. 42; from Callao Bay.

I find that in the genus *Belone*, the coronoid bone is distinct from the other mandibular bones, and is well-developed. In *Amia*, where it has been stated to be distinct, it is coössified in old individuals.

34. ORESTIAS CUVIERII Cuv. Val. XVIII p. 225.

Fin radii; D. 15; A. II. 16. Scales in fifty-three transverse series to above superior extremity of branchial fissure. Orbit one-fifth of head; length of head 3.5 times in total without caudal fin. Top of head and each side of anterior dorsal region naked.

No. 142. Lake Titicaca.

35. TETRAGONOPTERUS IPANQUIANUS, sp. nov.

This species is furnished with a series of teeth on the maxillary bone as in the *T. pectinatus*, *T. polyodon*, etc., but is only camparable to the latter in adding to this character, a reduced number of radii of the anal fin. It differs from it in the smaller and more numerous scales.

The head is short, and the lower jaw robust and somewhat protuberant. Its length enters the total with caudal fin 5.75 times; it includes the diameter of the eye four times, which enters the diameter of the very convex interorbital space 1.6 times. Muzzle abruptly descending, shorter than orbit. The proximal two-thirds of the maxillary bone toothed. Dorsal fin originating behind the basis of the ventral, its last ray standing above the first anal ray. Caudal fin deeply forked, the superior lobe larger. Radii; D. I. 9; A. I. 28. Scales 11–54–61–8. The general form is moderately elongate, the depth entering the length without the caudal fin, three and one-fifth times.

	M.
Total length	.125
Length to orbit	.005
" " dorsal fin	.044
" " anus	.051
" " anal fin	.057
" " caudal fin	.093

Color silvery, with a narrow dorsal dusky line, and a leaden shade along the upper part of the side, which continues to the notch of the caudal fin. The anterior part of this band is enlarged into a scapular spot.

Nos. 69–70 and 122 from the upper waters of the Urubamba, one of the sources of the Ucayale. The other species of this section of the genus, the *T. polyodon* Gthr. is from the neighborhood of Guayaquil.

Dedicated to the memory of the inca Ypanqui, who in the city of Cuzco on the Urubamba, the first of his line, devoted himself to monotheism.

36. **ENGRAULIS TAPIRULUS**, sp. nov.

There are minute teeth in both the jaws, and the obliquely truncated extremity of the maxillary bone does not reach the articulation of the mandible with the quadrate. None of the fin rays are elongate, and the muzzle projects in a compressed, conical form beyond the mouth. The length of the head exceeds the depth of the body, and enters the total length without the caudal fin, three and one-third times. The depth of the body enters the same, four and one-fifth times. The eye is large, the diameter entering the length of the head four and one-half times, and exceeding the length of the rather elongate gill-rakers. Fin radii; D. I. 11; A. 25; the former originating above a point behind the base of the ventral fins; its last rays standing above the base of the first anal ray. Its first ray is equidistant between the base of the caudal fin, and the line of the anterior border of the orbit. Scales in 36–7 transverse series, deciduous. Abdomen moderately trenchant.

	M.
Total length	.120
Length to orbit	.006
" " border of operculum	.080
" " ventral fin	.050
" " anal "	.070
" " caudal "	.100

This species is, according to the descriptions given by Dr. Günther, most nearly allied to the *E. surinamensis*, and *E. poeyi*, but differs in many respects. The two specimens probably came from Pacasmayo Bay.

37. **TRICHOMYCTERUS PARDUS** Cope, Proceedings Academy, Phila. 1874, p. 132.

Numerous specimens from Jequetepeque.

After comparison of this first with many individuals both old and young, of the *T. dispar*, my opinion in favor of its specific distinctness from that species is confirmed. In order to present its characters in connection with those of other *Trichomycteri*, the following table is presented. A large specimen of the *T. pardus*, which, according to the label, came from Callao Bay, differs from those from Jequetepeque in having small spots instead of the large blotches characteristic of the species:

I. Dorsal fin entirely in front of anal.

a. Dorsal partly over base of ventrals.

Head one-sixth total length;* D. 7–8; A. 5–6; form slender; spots few, large.................................... *T. pardus.*

II. Dorsal fin partly over anal fin.

a. Dorsal fin partly over ventrals.

Head 4.5 to 5.5 in total length; D. 9; A. 6; gray, uniform or black speckled.................................... *T. dispar.*

aa. Dorsal fin behind base of ventrals.

Head 5 times in total; D. 7; A. 5; closely marbled with dark brown above and below.................................... *T. rivulatus.*

Head 6 times in total; D. 7; A. 6; straw-colored with a few faint specks.................................... *T. gracilis.*

Head 6.5 and 7 times in total; D. 8; A. 6; coarse, brown, confluent blotches, finer above anteriorly; forming two series posteriorly with pale band between.................................... *T. pocyanus.*

The species *T. maculatus*, *T. punctulatus* and *T. areolatus* C. & V., are characterized by a larger number of rays (11–15) in the dorsal fin, than that found in any of the preceding.

38. TRICHOMYCTERUS DISPAR Tschudi; Günther, Catal. Brit. Mus. V, p. 273.

All the specimens of this species as above defined come from the head-waters of the Amazon, as was found to be the case by Tschudi (see Fauna Peruana). They are Nos. 89 and 92–4 and 101 from Tinta on the Vilcanota, the source of the Ucayali, elevation 11,400 feet; Nos. 57–60 and 113–121 from the Rio Urubamba at Urubamba, elevation 10,000 feet. The very young have an interrupted dark lead-colored lateral band, which with growth is resolved into spots, and disappears. None of the specimens present the numerous dorsal radii ascribed by Dr. Günther to his *T. dispar*, which is doubtless the *T. maculatus* of Cuv. Val.

39. TRICHOMYCTERUS RIVULATUS Cuv. Val Vol. XVIII, p. 495.

This species, which is characterized by a smaller number of dorsal radii than the last, among other points, is represented by a large specimen (No. 143) from Lake Titicaca. Native name, Suche.

40. TRICHOMYCTERUS GRACILIS Cuv. Val. XVIII, p. 497.

The principal characters of this fish have been already pointed out. I add the following:

The depth of the body is one-sixth the total length with caudal fin. The eye is a little nearer the line connecting the posterior borders of the opercula than that which is tangent to the end of the muzzle. Nasal barbel extending a little beyond the eye. Radii; D. 6½; C. 4–11–3; A. 5½; V. I. 5; P. 9.

The color is a greenish straw-color with very faint dots closely placed on the dorsal region; lower surfaces unicolor; spots more distinct on top of head. An indistinct dark band extends on each side of the dorsal region from the beard to behind the dorsal fin.

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* Including caudal fin.

	M.
Total length	.290
Length to end of operculum	.042
" " ventral fin	.140
" " vent	.151
" " dorsal fin	.160
" " anal "	.170
" " caudal "	.250

This species resembles the light varieties of the *T. dispar*, but differs in the more posterior position of the dorsal fin, and the smaller number of its radii.

No. 91, large specimen from Tinta

I give the above description of a species probably named by Cuvier and Valenciennes, but no one can ascertain from their writings whether this is the case or not.

41. TRICHOMYCTERUS POEYANUS Cope, sp. nov. *Trichomycterus rivulatus* "Cuv. Val." Cope, Proceed. Academy, Philada. 1874, p. 132.

This species, formerly identified by me as above, I now name, dedicating it to my friend Prof. Felipe Poey of Havana.

42. ARGES SABALO Cuv. Val. XV, p. 335. Nos. 62–6 and 115 and 123, from the Rio Urubamba, at an altitude of 10,000 feet.

43. OPHICHTHYS UNISERIALIS, sp. nov.

Maxillary and mandibular teeth acute, in two series ; premaxillary and vomerine teeth in single series ; no distinct canine teeth, the premaxillaries the largest. Cleft of the mouth moderate, two-fifths the length of the head, which is one-half that of the body. Muzzle slightly projecting more than twice as long as the diameter of the eye. Body less than half as long as the tail. Pectoral fin a little more than one-third the length of the head, the dorsal originating nearly above its posterior sixth. Free portion of the tail very short ; the terminal inch of both dorsal and anal fins enclosed in a deep groove between two vertical dermal laminæ. Length M. 0.330.

Color above dark brown, below a little paler, the two colors separated by a water line. Along the lower border of the dark brown is a series of small yellowish spots a half inch apart, which are invisible on the posterior half of the length.

From Peru, probably Pacasmayo.

A species allied to the *O. parilis* and *O. dicellurus* of Richardson.

44. MUSTELUS MENTO, sp. nov.

Snout elongate, the length anterior to the mouth, exceeding the width between the external borders of the anterior nostrils, and considerably greater than the length between the angles of the mouth, external measurement. Anterior base of the anterior dorsal fin above the middle of the inner border of the pectoral fin ; the extremity of posterior portion reaching the line drawn vertically from the base of the ventral fin. The posterior extremity of the base of the second dorsal stands above the beginning of the last third of the base of the anal. The proximal portion of the inferior limb of the caudal fin, is very little prominent. The teeth are transverse and present only a low transverse median keel.

Uniform leaden brown above ; below light yellowish brown.

	M.
Total length	.303
Length to bases of superior teeth	.026
" " pectoral fins	.072
" " ventral fins	.143
" " anal fins	.202
Width between upper lips at angle of mouth	.019

From the Pacific Ocean at Pacasmayo, Peru.

This shark differs from the species described by Günther in the relatively long muzzle and narrow arcade of the mouth, excepting in the case of the *M. manayo* Schleg., which differs from the *M. mento* in the more posterior position of the dorsal fin. Prof. Gill has described two species from the Pacific Ocean, the *M. californicus* and *M. dorsalis*.* The former differs from the present one in the more posterior position of the ventral fins which are considerably behind the posterior angle of the dorsal, and the muzzle is shorter. In the *M. dorsalis* from Panama the dorsal fin is, according to Prof. Gill, more posterior in position, since only one-fourth of its base stands above the pectoral ; in *M. mento*, three-fourths of the base of the dorsal stands above the ventral fin.

45. PSAMMOBATIS BREVICAUDATUS, sp. nov.

Anterior borders of the disc broadly rounded, consisting of the anterior portions of the pectoral fins, the only indication of the snout being a small tubercle below the median point. Disc broader than long, subrhombic, the lateral margins broadly rounded. Posterior border of pectoral fin overlapping the anterior part of the ventral. Ventral fins with the border not very deeply emarginate. Tail only one-fifth longer than the claspers, with broad lateral fold, two superior, and a rudimental terminal fin. Nasal fissures with two laminæ, which are not united with each other nor with those of the opposite side. The posterior or internal is anteroposterior, the anterior or external, is rolled into a tube.

The distance between the outer margins of the nostrils is equal to that between each one and the extremity of the snout, and one-half greater than that between each and the nearest part of the margin of the disc. The interorbital space is little concave, and is wide, exceeding the combined length of the orbit and spiracle. The upper surface of the head, and a broad band on both surfaces of the anterior part of the disc are covered with minute spinules. The other surfaces are smooth, with the following exceptions. Two spines anterior to the orbit above ; a spine near the

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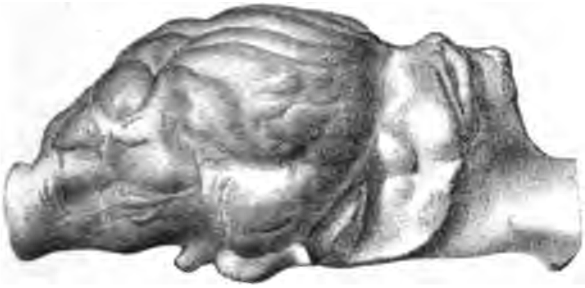
* Proceedings Academy, Phila., 1864, p. 148–9.

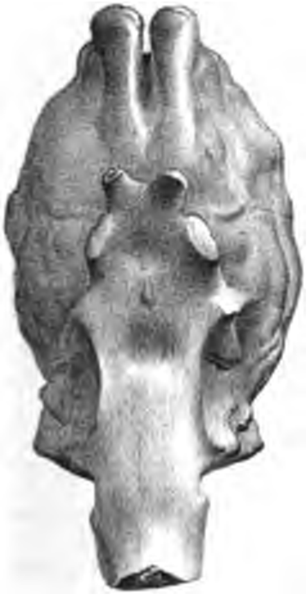
roc. Amer. Phil. Soc. Vol. XVII, No. 100, p. 36, 1877.

Pl. I.

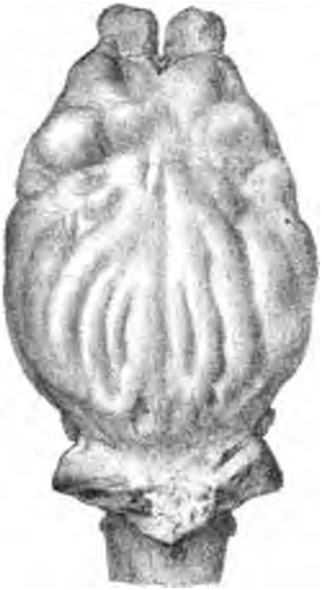
1



3



2



Procamelus occidentalis $\frac{2}{3}$.

UNIV. OF

inner border of the spiracle. A row of a few spines between the orbit and the lateral free border, nearer the latter; six or eight on the median line of the middle portion of the back; a double row parallel to the border of the pectoral fin, extending an inch within it, on its anterior half only; a series on the median line of the tail.

	M.
Total length	.307
" width	.270
Length to mouth	.038
" " vent	.190
" " base of tail	.215
Expanse of ventral fins	.137
Interorbital width	.029

Upper surfaces lead colored with indistinct darker shades; middle of the anterior portion of the muzzle pale, with a dark spot behind it.

From the Bay of Pacasmayo, Peru.

On the Brain of Procamelus Occidentalis.

By E. D. Cope.

(*Read before the American Philosophical Society, May* 4, 1877.)

I obtained a complete cast of the cranial chamber of the *Procamelus occidentalis*, which bears a fair proportion to the general dimensions of the skull. As compared with a llama of about the same size, the facial portion of the skull is longer, while the postorbital portion is as long, but narrower. This is indicated by the following measurements:

	Procamelus occidentalis.	Auchenia lama.
Length of skull anterior to orbit	.180	.153
" " posterior "	.110	.105
Width " at anterior border of orbit	.080	.090
" " middle of zygomatic fossa	.062	.065

The olfactory lobes of the brain have nearly the same position in the two species, extending anteriorly to opposite the middle of the orbits.

The brain exhibits large cerebellum and hemispheres, and rather small olfactory lobes. The cerebellum is entirely uncovered by the hemispheres but is in contact with them. The lateral lobes and vermis are well developed. The hemispheres are well convoluted, the longitudinal posterior convolutions giving way anteriorly to lobulate ones. The sylvian fissure is well marked. The sides of the medulla oblongata are compressed and vertical at the pons, in correspondence with the vertical position of the petrous bones. The origins of the ophthalmic and maxillary branches of the trigeminus nerve are not divided by a septum, while that of the mandibular branch is quite distinct from the others. The optic nerves are large. The olfactory lobes are separated by a deep fissure below the extremity of the hemispheres; they project freely beyond the latter, being separated by a deep fissure. Their free portions are short, truncate and compressed. The anterior pyramids are not preserved on the inferior face of the cast of the medulla oblongata. The hippocampal lobes are subround and protuberant.

From the detailed description following, it may be derived, that while the arrangement of the convolutions of the anterior lobes of the hemispheres is more simple than in any recent Ruminant, that of the middle and posterior lobes is essentially similar to that characteristic of the latter order of *Mammalia.**

The brain displays the characters of the older types of *Ruminantia*, although not materially smaller than that of the llama, an animal which it equaled in general proportions. The hemispheres are, however, not produced so far posteriorly in the *Procamelus* as in the *Auchenia*, reaching only to the line of the *meatus auditorius externus* in the former.

The vermis of the cerebellum rises abruptly from the medulla, having a nearly vertical direction to a point a little lower than the superior plane of the hemispheres. The lateral lobes extend on each side of it, each one having a rather greater width that the vermis. Their posterior faces are sub-vertical, and are directed slightly forwards. Each projects laterally into an apex at the middle of its elevation, and then contracts downwards into the angular line which marks the posterior border of the petrous bone. From a point between each apex and the vermis a ridge rises obliquely inwards to the superior plane of the cerebellum, where each one enlarges and joins the median transverse line. The angle above described as descending from the lateral apex of the cerebellum curves forwards, forming a lateral angular border of the pons varolii on each side. The flat space enclosed between this line and the posterior border of the hemisphere is interrupted by two prominent tuberosities. The superior is small, sub-oval, and is near to the posterior border of the hemisphere. The other is a short prominent ridge directed downwards and forwards, just behind the lobus hippocampi. Its inferior end corresponds with the origin of the mandibular branch of the trigeminus, and perhaps the facial nerve.

The medulla oblongata is contracted at the foramen magnum, and has a sub-round section slightly flattened below. Its inferior face is then rounded, then flattened, and then concave between the anterior part of the lateral ridges. The bases of the maxillary branches of the trigeminus nerves are stout, and directly in line with the origins of the mandibulars. Between them the base of the brain is concave, and the optic nerves issue but a little distance in front of them. The lobi hippocampi are sub-round and rather prominent; they are terminated in front at the foramen spheno-orbitale by the contraction of the cranial walls. Their surface displays slightly defined convolutions, the best marked being inferior and subround in form.

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* See Paul Gervais' Journal de Zoölogie, I, 1872, p. 459.

The cerebral hemispheres, viewed from above, have an oval outline, and are rather narrower anteriorly than posteriorly. They contract posteriorly from the sylvian convolution. The profile descends gradually to the olfactory lobes. The superior surface is little convex in the transverse direction. The fissure of Silvius is nearly vertical in position, and its superior extremity is visible from above. A strongly marked fissure extends posteriorly from it, defining the lobus hippocampi above. The sylvian convolution the thickest of all, and its outer border is emarginate in front and behind; below the postero-superior emargination it is thickest and most protuberant. Between it and the position of the falx there are three longitudinal convolutions, the external, the median, and the internal. These are slightly divergent posteriorly, but the posterior extremities of those of one side tend to unite on the posterior border of the hemisphere. Their surfaces are smooth. The external is widest medially; and it terminates anteriorly just behind the apex ef the sylvian convolution. The internal is double posteriorly; the median is simple, and unites with the internal above the apex of the sylvian convolution. The two conjoined continue for a short distance and terminate in a broad tuberosity. Below the external convolution on the side of the posterior part of the hemisphere there are four small longitudinal convolutions. The orbital portion of the hemispheres is extensive, and nearly smooth from the olfactory lobes to the supraorbital border. This is not prominent, but is represented by a short longitudinal ridge. Above each of these, on the superior or front aspect of the hemispheres, is a massive convolution bent crescent-shaped, with the convexity inwards. The posterior part of the convolution is a sub-round tuberosity which stands opposite to, and in front of, the furrow separating the sylvian and median convolutions. The middle part of the crescent is less prominent, but the anterior extremity forms another tuberosity whose long axis is directed downwards and outwards. The crescentic convolution of the one side is separated from that of the other by a wide, shallow, median longitudinal groove, which extends transversely at the posterior tuberosities. The two tuberosities and the olfactory lobes form three descending steps.

As compared with the brains of the existing *Bovidæ* that of the *Procamelus* differs in the forms of the cerebellum and medulla oblongata as already pointed out. The hemispheres differ in being shorter behind and more depressed in front. The convolutions of the posterior region are the same in number as in the sheep, but are less undulating in their outlines; but there is a marked difference in the anterior convolutions. The median convolutions do not, as in the sheep, extend to the extremity of the anterior lobe, but terminate above the sylvian fissure, so that there only remain in front of them the two large supraorbital convolutions, instead of the four common to existing *Bovidæ* and *Cervidæ*.* In this respect it more nearly resembles *Oreodon*, but in this genus the internal convolution is continuous with the supraorbital.*

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* See Leuret et Gratiolet Anatomie comparée du Systeme Nerveux, 1839-57, Atlas, pls. vii-x.

EXPLANATION OF PLATE.

Brain of *Procamelus occidentalis* from a cast, two-thirds the natural size.
Fig. 1. View of the left side.
Fig. 2. View of the superior surface.
Fig. 3. View of the inferior surface.

On the Vertebrata of the Bone Bed in Eastern Illinois.

BY E. D. COPE.

Read before the American Philosophical Society, May 20, 1877.

It is already well known that a few years ago, Dr. J. C. Winslow discovered in the Eastern part of the State of Illinois, a bone bed containing the fragmentary remains of reptiles and fishes. From some of this material placed in my hands, I identified four species of Vertebrata, two Rhynchocephalian reptiles, one a Dipnoän and one Selachian fish†. These were named, *Cricotus heteroclitus, Clepsydrops collettii, Ceratodus vinslovii*, and *Diplodus* sp. indet. It was stated in connection with the descriptions of these, that they indicate Triassic or Permian age for the bed in which they were found, since on the one hand *Reptilia* have not been found in the coal measures, nor on the other hand has the genus *Diplodus* been found above the Carboniferous series of rocks.

Doctor Winslow, in response to my inquiries, has sent for my examination another series of these fossils, which contains several species not previously known from the formation. Subsequently William Gurley discovered another exposure of the bone bed, and obtained a number of useful specimens, including some of species not previously known, which he also kindly placed at my disposal. To both these gentlemen I desire to express my sense of the obligation under which they have laid me. Descriptions of some of the species are now given; a complete account of the fauna is reserved for an illustrated memoir now in preparation.

STRIGILINA LINGUÆFORMIS Cope, gen. et sp. nov. Petalodontidarum.

Char. Gen. The tooth is a flat osseous plate whose outline is pyriform, the wider end recurved in one direction as the transverse cutting edge; the other extremity narrowed and recurved in the opposite direction as the root. The side from which the cutting edge arises is crossed by numerous plicæ from the base of the root to near the base of the cutting edge; the opposite side is smooth.

The genus appears to resemble most nearly the *Climaxodus* of McCoy, especially such species as the one figured by T. P. Barkas in the Atlas of his Manual of Coal Measure Paleontology Pl. I figs. 35-7 (Manual p. 20). From the latter it differs in the transverse instead of continuous relation of the edge and root to the main body of the tooth ; the root does not appear to be differentiated at all in *Climaxodus*, while it is distinctly marked in *Strigilina*.

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* Leidy, Extinct Fauna, Dak. and Nebraska, pl. xiv, fig. 11.

† Proceedings Academy Philadelphia, 1876, p. 404.

Char. Specif. The plicate surface terminates behind in a median angle, at the base of the root. There are eight plicæ which all cross the plane, excepting the sixth, which is interrupted in the middle by the strong angulation of the seventh, which touches the fifth. The lateral extremities of the right are in contact with the base of the recurved cutting portion. The latter is convex transversely, leaving a smooth surface between it and the eighth plica. The smooth side of the tooth is shining, and there is a shallow fold which passes round its side and crosses just at the base of the recurved cutting lamina. The edge of the lamina is unfortunately broken.

	M
Total length of plane	.008
Width at base of cutting lamina	.006
Width at base of root	.004
Thickness of plane portion	.0015

This species was found by William Gurley.

SELACHII.

DIPLODUS ?COMPRESSUS Newberry.

A few teeth of *Diplodus* found, are none of them perfectly preserved. One with a lateral and median denticles nearly complete, agrees pretty well with the species cited.

DIPNOI.

CERATODUS VINSLOVII Cope Proceed. Acad. Philada. 1876, p. 410.

CERATODUS PAUCICRISTATUS Cope, sp. nov.

The single tooth representing this species is narrow in the transverse direction, but stout in vertical diameter. But four ridges are present, all of which have a single direction, but the shorter ones are the less oblique to the long axis of the tooth. They all extend into the inner border, but become low as they approach it. Distally they are quite prominent, but do not project very far beyond the emarginate border between them. The inner border is plane and vertical, and without ledge ; the inferior surface is concave in the transverse direction. The surface of the tooth is minutely and elegantly corrugated.

Length from base of second rib	.0170
Depth at base of second rib	.0045

From the collection of Dr. J. C. Winslow.

CTENODUS FOSSATUS Cope, sp. nov.

Represented by a nearly perfect tooth of a general narrow and vertically thickened form. There are five crests, the largest three extended in one direction, and the other two in the other. Between the last of the latter and the inner border is a rudiment of another in the form a rugosity. None of the crests touch each other at their bases. At their extremities they curve rather abruptly downward, and do not project beyond the inferior plane, from which each one is separated by a deep fossa, whose mouth is a notch in its base. The crests are coarsely dentate, there being three or four teeth on each, and the grooves between them are marked by coarse transverse undulating grooves. The inner border is a deep vertical plane; the inferior face is narrow and concave in transverse section.

Total length	.022
Greatest width	.007
Depth at middle	.006

This is the first species of this carboniferous genus found at this locality. It differs from the *C. serratus* Newberry in its narrow form, small number of ridges, and the very slight prolongation of their extremities.

Ctenodus gurleyanus Cope, sp. nov.

This species is indicated by a portion of a tooth, which leaves the number of the ridges a matter of uncertainty. On this account its description might have been postponed, but that the distinctness of its characters, render it clear that it cannot be placed with any of the other species. The crown, as in *Ceratodus paucicristatus*, is narrow and rather thick; but three crests are present, all radiating in the same general direction, the longer close to the inner border. There was not more than one additional crest, or one and a rudiment, and these have probably the same direction as those which are preserved. The crests are sharp, elevated, and coarsely dentate; they are not decurved at the extremity, but cease abruptly with a projecting denticle, beneath which the basis is excavated by a shallow fossa. The inferior face is slightly concave, the internal wall vertical.

Greatest width	.008
Depth at inner border	.005

This *Ctenodus* is dedicated to William Gurley, to whose efforts science is indebted for this and several other interesting paleontological studies.

CROSSOPTERYGIA.

Peplorhina arctata sp. nov.

Based on an unsymmetrical bone, bearing teeth, to be referred to the position of pharyngeal, pterygoid, palatine, or half of the vomerine elements. From the resemblance of the teeth to those on the palate of *Peplorhina anthracina*, I refer it provisionally to the corresponding position in the mouth of a second species of that genus. This course is open to modification should subsequent investigation require it.

The bone is plate-like and diamond-shaped, with the longer angles both recurved. The convex surface is thickly studded with teeth, which are not in contact with each other. Their size increases from one side of the bone to the other, and still more, from one extremity to the other. The crowns are swollen at the nearly sessile base, and contract rapidly to a conical and unsymmetrical apex. Those of the smaller teeth are more conical, those of the larger more bulbiform. One side of the latter is slightly concave below the apex. The surface is shiny and distinctly grooved. Fractured crowns do not display any central cavity. There are sixty-five teeth on the plate.

Length of plate	.013
Width on short border	.007
Transverse width	.007
Depth	.002

OTHER TEETH.

Teeth of four other species have been found by Doctor Winslow, to which I allude only briefly, as their characters are not sufficient to enable me to distinguish them from those of known genera and species.

Species one. This is represented by a fragment of mandibular ramus, which supports six teeth, all of which have a greater or less part of their apices broken away. They stand in close juxtaposition, and are of equal sizes. The basal half or more of the crown displays the character of deep inflections or grooves. These teeth belong to some sauroid fish, or to a batrachian.

Specie two. This is also represented by a portion of mandibular ramus which supports four teeth. The anterior of these is larger, and is separated from the others by an edentulous space. Their crowns are rather elongate and are compressed, having cutting edges fore and aft. Both edges contract to the apex, but the anterior the most so. There are a few shallow grooves at the base, but they appear to be superficial only. These teeth might belong to either a reptile or a batrachian, and it is useless to attempt to distinguish them by a name from the many genera of both classes that resemble them.

Species three. Two stout, slightly flattened, conic teeth without cutting edges. represent this species. They are anchylosed to a very thin plate of bone, a part of which adheres to each. The base is oblique, expanding more in one direction than another. The greater part of the crown is marked by closely placed parallel grooves, which are much more numerous than in the species No. 1. They are larger than these or No. 2, measuring .004 in diameter at the base. They may belong to any one of a number of known genera of Batrachia, or Sauroid fishes.

Species No. 4. These are more numerously represented than the others, occurring in Mr. Gurley's collection as well as in Dr. Winslow's first collection. There is nothing to prevent their reference to the *Lacertilia*, and I have thought that there is some probability of there being referable to the *Clepsydrops collettii.* They are not rooted, but are anchylosed in a shallow concavity of the jaw bone, which is only distinguished from that for the adjacent tooth by the corresponding scolloping of the lower margin of the jaw. The opposite margin is a little more elevated and is more closely anchylosed to the base of the tooth. The crown is conic, subround in section, and curved backward. There are no cutting edges, and the base is a little flattened in front and in behind. On each of the faces thus formed, there is an open, shallow groove, sometime obsolete. There are no other grooves nor sculpture on the teeth.

Each specimen of this tooth is single, and anchylosed to the same (corresponding) part of the jaw. The tooth is at one extremity of the alveolar groove; above the opposite end is the basis of a bone attached at right angles (? prefrontal or malar). One of the specimens displays an extensive pulp cavity.

Length of crown	.010
Diameter at base	.004

ACTINOPTERI.

In the transactions of this Society, published in 1871, and more fully in the Proceedings of the American Association for the Advancement of Science, at the meeting of 1871 (published early in 1872), I showed that the supposed order of Ganoids as defined by Müller, is not a homogeneous or natural association of types. I pointed out that the recent genera must be distributed between two divisions of fishes of high rank, viz.: the *Crossopterygia*, and the *Actinopteri*. The last-named division was believed to include the fishes previously known as *Chondrostei* and *Teleostei*. Some of the so-called Ganoids of Müller and Agassiz were referred to different subdivisions of the *Actinopteri*. In a paper recently published in the Proceedings* of this Society, a better expression of natural affinities was thought to be obtained, by regarding the *Crossopterygia*, the *Chondrostei*, and the *Actinopteri*, as forming a single sub-class of the class Pisces, under the name of *Hyopomata*, the other sub-classes being the *Dipnoi*, the *Selachia*, and the *Holocephali*.

I had already referred *Phaneropleuron*† to the *Dipnoi*, when Dr. Günther's and Prof. Huxley's researches into the structure of *Ceratodus forsterii* led them to place this genus also in the same sub-class. Günther also refers the fossil genera *Dipterus*, *Chirodus* and *Conchodus* to the *Dipnoi*, and with these must go *Ctenodus* and its immediate allies. The *Polypteridæ* and *Cœlacanthidæ*, which were arranged by Huxley, with the preceding forms in his sub-order *Crossopterygia*,‡ are clearly *Hyopomata*, having well developed hyomandibular and maxillary bones, as well as characters of the pectoral fins equally wanting to the *Dipnoi*. It is thus evident that the division *Crossopterygia*, as left by Huxley, cannot be maintained, but that it must rest entirely on the definitions given by me in the papers above quoted, where the two families mentioned were the only ones referred to it. It is possible that a strict adhesion to the law of priority will require that the name *Ganoidei* should be retained for this division.

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* May, 1877.

† Transactions American Philosophical Society, XIV, 1871, p. 450.

‡ Memoirs of the Geological Survey, Great Britain, Decade X.

The tribe *Actinopteri* as left in my latest paper above quoted (May, 1877), has slightly different boundaries from those originally prescribed for it, since the *Chondrostei* are now excluded from it. As then and now understood, it is nearly identical with the *Teleostei* of Müller, a name which I should adopt for it, were it not that some of his *Ganoidei* and numerous extinct forms with unossified vertebral column belong to it. For such fishes the name of Müller is too glaringly inapplicable to be employed.

After excluding the extinct genera of *Hyopomata* which are clearly *Crossopterygia* and *Chondrostei*, there remains a numerous assemblage, whose relationships to existing types of fishes have never yet been ascertained. I refer especially to the families of the *Lepidoides*, *Sauroides* and *Pycnodontes*, of the Poissons Fossiles of Agassiz, and other forms subsequently described; among others, the *Dorypterus* of Germar. The only bond which retained these forms in connection with the fossil Crossopterygian fishes, the rhombic and enameled scales, may be safely disregarded in view of the important characters of the skeleton which declare their affinities to be diverse; the more as some of the latter (*Cœlacanthidæ*) have rounded scales, and *Leptolepis* and other genera referred by Agassiz to the Sauroides, have cycloid scales. The heterocercal character of the tail of some of them, is of but little greater weight. I have already shown that fishes presenting this character (*Lepidosteus*, *Amia*) do not differ in other respects from other *Actinopteri*, while the still lower isocercal condition is often seen in the latter. Further, the extinct genera do not agree among themselves in this respect, some bring heterocercal, and some isocercal.

The question remains as to the proper location of the families just named, in the tribe *Actinopteri*. It has been impossible to discover all of the characters necessary to the fullest elucidation of this question, but the greater number of them have been satisfactorily ascertained. The following results are therefore approximations to the truth which I believe that future researches into the osteology will confirm. At the least they are much nearer to an expression of nature than any yet attained.

As regards the general affinities represented by the terms *Physostomi* and *Physoclysti*, there is no doubt that the *Lepidoides* and *Sauroides* exhibit the former. This is seen in the uninterrupted conjunction of the parietal bones (where it has been possible to observe the parts), and in the abdominal position of the ventral fins, and extent of the maxillary bone; as well as in the less important features of the absence of all ctenoid characters of scales and preoperculum, lack of spinous rays, etc. The *Pycnodontidæ* present in general similar characters, and add nothing which should separate them widely from the Lepidoid genera of Agassiz, especially the family of the *Dapediidæ*. Like these, however, they approach nearer to the *Physoclysti* in the anterior continuation of the interneural spines as far as the skull. This character is found also in some *Physostomous* fishes, *i. e.* the greater number of *Characinidæ*, the *Elopidæ*, *Umbridæ* and some

Nematognathi. The *Dorypteridæ* present a number of peculiar features, approaching still more closely the *Physoclysti* in their thoracic ventral fins.

We may now consider the relations of the Lepidoides and Sauroides to the known physostomous orders.

The scapular arch being suspended to the cranium renders comparison with some recent orders with a free scapular arch, unnecessary. The simplicity of the anterior vertebræ leaves out of account the *Nematognathi* and *Plectospondyli.* The only orders with which we can compare them are those represented by their old companions in the Poissons Fossiles, the *Ginglymodi,* the *Halecomorphi* and the *Isospondyli.*

Although the *Sauroides* included the genus *Lepidosteus* in Agassiz's system, I cannot find that any of the fishes of the two families under consideration possess the peculiar vertebræ of that genus, which in part characterizes the order *Ginglymodi.* Neither have any of them the segmented maxillary bone. The real alternative is between the last two of the above named orders. Now the principal skeletal character which distinguishes these two, is found in the pectoral fin. In the *Halecomorphi* there are numerous basilar radii attached to a cartilaginous mesopterygium, in the *Isospodyli* there are but three or four such bones sessile on the scapular arch. After examining a number of specimens of species of both the Agassizian families named, I have been unable to discover any basilar bones whatever, and have suspected that they were, in the complete skeleton, of cartilaginous character, Professor Agassiz figures this region in his restoration of the "Lepidoid" genus *Platysomus,* and of the "Sauroid" genera *Macrosemius* and *Caturus.* In these, he represents the small number of basilar bones characteristic of the *Isospondyli,* and placed in the close relation to the scapular arch, which is seen in the same order. A consultation of the numerous figures given by Agassiz, Thiolliere, and others, has failed to discover a single instance exhibiting the peculiar basilar pectoral bones of *Amia.* This could scarcely be so uniformly the case did such bones exist, so that with Prof. Agassiz restorations coinciding, I can only for the present refer these fishes to the *Isospondyli.*

Their other special characters are so numerous, that they must be taken account of in deciding on their ordinal relations. If we, for the present, distinguish the two families as did Agassiz, we include in the Lepidoides the genera with teeth *en brosse* or in a single row, and sub-equal and obtuse; and in the Sauroides the genera with teeth of unequal sizes, some being large and raptorial, the others minute. Of the Lepidoid genera, Agassiz states that the vertebræ are osseous in *Lepidotus,* and says the skeleton of *Amblypterus* is osseous, without particularizing the vertebræ. The posterior vertebræ of *Palæoniscus* he states to be ossified, while in *Platysomus, Tetragonolepis* and *Dapedius,* the centra are not certainly osseous. In all of these genera the neural and hæmal arches are distinctly articulated with the centra. *Platysomus, Dapedius* and *Tetragonolepis,* present the important character of a series of basilar interneural and interhæmal bones, the interneurals commencing in *Platysomus* at the head.

This character separates these species widely from the other genera of the "*Lepidoides.*"

As regards the "*Sauroides,*" the vertebral centra are always represented as ossified, and the neural and hæmal arches articulated, with the possible exception of *Thrissops*[*] where the arches are represented as continuous; the same point is not certainly determined in *Eugnathus.* None of the genera which I have seen, have the basilar interneural and interhæmal spines found in the *Dapediidæ*, above mentioned, nor are they figured or described by authors.

In these characters of the two groups, there is nothing allying the genera to the *Halecomorphi* rather than to the *Isospondyli.* The absence of the basilar interhæmals from all excepting the *Dapediidæ* is additional evidence of Isospondylous affinities. The ganoid scales of most of the genera, do not separate them from the typical forms of this order more widely than the *Arapæma,* nor the vertebrated caudal fin more widely than the existing *Notopterus.* The number of vertebræ included in the axis of the caudal fin in the extinct genera is shown by Agassiz to be very variable. In *Megalurus,* this region resembles that of *Amia;* in *Leptolepis* and *Caturus,* the vertebræ are not more numerous than in the *Saurodontidæ,* while in *Thrissops* the fin is homocercal, in the Agassizian sense.

As already remarked, the *Pycnodontidæ* present some points of resemblance to the *Dapediidæ.* All the points necessary to a complete elucidation of their structure have not yet been observed, so that my conclusions are necessarily imperfect. A point of resemblance to the *Plectognathi* is seen in the cartilaginous space between the interneural and interhæmal spines and their respective fins; a space occupied in the *Dapediidæ* and *Dorypteridæ,* by the basilar interneurals and interhæmals. This character is however not universal in the *Pycnodontidæ.* Prof. Agassiz speaks (Poissons Fossiles) of a maxillary bone, which bears a few teeth, in this family. This character will distinguish it at once from the *Plectognathi* and all other physoclystous orders. The abdominal position of the ventral fins and unmodified anterior vertebræ, indicate that these fishes may for the present be placed with the preceding, in the *Isospondyli.* There they are well distinguished by the peculiar inverted chevron-like bones which protect the dorsal and lateral regions in front of the dorsal fin. Prof. Agassiz describes the vertebræ of *Pycnodus* as osseous; M. Thiolliere figures some species as without osseous centra, a condition I have observed in some specimens.

The characters of the *Dorypteridæ* are, according to the very full description of Messrs. Hancock and Howse,[†] more strongly peculiar. Although these fishes may be referred to the *Physoclysti,* on account of the thoracic position of their ventral fins, they present features which will not permit a reference to any known order. It has been shown that they possess the basilar interneural bones, which as I have pointed out,* only exist in the *Physoclysti* in small development in the *Batrachidæ*; and occur in various degrees of development in some *Physostomi*, being especially elongate in the anal fin of *Amia*. It is even possible that another element enters into the series connecting the neural spines with the dorsal fin-rays. The pectoral fin possesses fourteen or fifteen basilar radial bones; a character which like the last, is not found in the *Plectognathi*; these fishes having but three or four such elements. These two points indicate a lower position than that of the latter order, and a relation to it similar to that which *Amia* bears to the *Isospondyli*. It goes to show that even among some of the earlier fishes, physoclystous characters were foreshadowed. I therefore establish a new order for its reception to take its place at the base of the line of Physoclysti.

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[*] Description des Poiss. Foss. prov. d. l. Gisem. Jurass. d. le Bugey; premiere livr. Thiolliere et Gervais.

[†] Quarterly Journ. Geolog. Society, London, 1870, p. 623.

As a résumé of the preceding inquiry, the following table of the families treated of, with their definitions, is now given:

Order ISOSPONDYLI.

Physostomous fishes with distinct parietal bones; unmodified anterior vertebræ; and three or four basilar bones of the pectoral fin. Symplectic and præcoracoid bones present so far as known.

Fam. SAUROPSIDÆ (*Sauroides* Agass. partim.)

Teeth of different sizes, the large raptorial ones mingled with small ones; vertebral column osseous; no basilar interneurals or interhæmals.

1. Caudal fin with many vertebræ; scales rhomboid;—*Pygopterus, Eugnathus.*
2. Caudal fin with few vertebræ; scales rhomboid;—*Pachycormus,*† *Sauropsis, Macrosemius, Belonostomus, Aspidorhynchus.*
3. Caudal fin with numerous vertebræ; scales rounded;—*Megalurus, Callopterus,*‡ *Attakeopsis.*‡
4. Caudal fin with few vertebræ (in some instances apparently none); scales rounded;—*Caturus, Leptolepis, Anædopogon,*§ *Thrissops.*

Fam. LEPIDOTIDÆ, (*Lepidoides* Agass. partim.)

Teeth simple, often obtuse, in one or many rows, without elongate ones intermixed; no basilar interneurals or interhæmals; vertebræ with the centra incompletely ossified;‖ (scales rhomboid; caudal fin vertebrated.) *Amblypterus, Palæoniscus, Eurynotus, Semionotus, Lepidotus, Pholidophorus, Microps, Notagogus, Ophiopsis, Cosmolepis, Pleuropholis.*

Fam. DAPEDIIDÆ mihi.

Teeth uniform, obtuse; vertebræ with incompletely ossified centra;‖ the interneural spines commencing at the head; a complete series of basilar interneural and interhæmal spines;¶ *Platysomus, Dapedius, Tetragonolepis.*

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* Transac. Amer. Philos. Soc. 1871, XIV, p. 451.

† Vide *P. heterurus* and *P. macropterus* Ag.

‡ Thiolliere et Gervais Poissons Foss. de Bugey.

§ Cope, Proceedings American Philosophical Society, 1871, p. 53.

‖ These statements are derived from Agassiz, Poissons Fossiles.

¶ Agass. Poiss. Fossiles, II. Pl. D. fig. 2.

Fam. PYCNODONTIDÆ.

Teeth obtuse molar, covering the vomer and palatine bones; no basilar interneural and interhæmal bones; chevron-shaped bones protecting the dorsal region, their branches extending on the sides; abdomen protected by similar bones, which form plates on the median line; interneurals continued far forwards.—*Microdon*, *Pycnodus*, *Gyrodus*, *Mesodon*.

Order DOCOPTERI mihi.

Scapular arch suspended to the cranium; pectoral fin with numerous, (not more than fifteen known) basal radii; ventral fins thoracic. Dorsal and anal fins with basilar interneurals.

Fam. DORYPTERIDÆ.

Vertebral column osseous; caudal fin not or very shortly vertebrated. Interneural spines corresponding with the basilars on the abdominal, but not on the caudal parts of the vertebral column. Ribs complex, united with abdominal dermal bones which form a series of median plates.

None of the Isospondylous families above described possess the dental characters of the *Saurodontidæ*, i. e. the long fangs set in deep alveoli.

RHYNCHOCEPHALIA.

CLEPSYDROPS COLLETTII Cope, Proceedings Academy, Philadelphia, 1876, p. 407.

This species proves to be the most abundant land vertebrate of the formation. It is represented in all the collections, sometimes by portions of individuals of double the size of the types. I referred this genus to the *Rhynchocephalia* originally, although it possesses a few batrachian characters. The occipital condyles preserved in the present collection are simple and median, thus confirming the reference, were confirmation needed. A supposed sacral vertebra is free at both extremities, and presents on each side, just behind the articular extremity, a very large facet, extending from a rudimental diapophysis to the plane of the inferior surface of the centrum. The specific reference of this vertebra is not certain.

CLEPSYDROPS VINSLOVII Cope, sp. nov.

This species is represented by a third cervical vertebra; and probably by other centra, but in this one the characters distinguishing it from *C. collettii* are especially visible.

The inferior median line is a keel, some distance above it, the sides of the centrum are full, rising in a longitudinal angle. There is no constriction or fossa below the diapophysis as in *C. collettii*, The latter is anterior in position, is vertically compressed, and is curved forward for a short distance below. The posterior articular face is regularly funnel-shaped from the margin; the anterior face has a broad recurved lip. This passes round the inferior margin, which is not projected forwards as in *C. collettii*. The zygapophyses are well developed, and stand close together. The neural spine is compressed, and the basal portion points somewhat forwards.

		M.
Length of centrum		.011
Diameter of posterior articular face	vertical	.009
	transverse	.009
Vertical diameter of diapophysis		.006
Expanse of posterior zygapophysis		.009
Anteroposterior diameter of base of neural spine		.005
Transverse diameter of neural arch		.006

CLEPSYDROPS PEDUNCULATUS, sp. nov.

Established on two vertebræ obtained by Mr. Gurley, of a lizard of larger proportions than any of those belonging to the other species of the genus. One of these is a third cervical and the other is apparently a dorsal; both differ from corresponding vertebræ of *C. collettii* and of *C. lateralis* in having elongate diapophyses for the attachment of the ribs. These are present in the other species, but are either very short, or sessile. The third cervical has a broad reverted anterior lip-like margin of the anterior articular face, which resembles the corresponding part in *C. lateralis* in not being produced below. The median line is keeled, and there is a shallow longitudinal groove on the upper part of the sides. The posterior articular face is regularly funnel-shaped. The diapophyses are very stout, and are directed a little downwards and strongly backwards. The articular faces are single, look downwards and outwards, and are wide above, and narrow below. The base of the neural canal is deeply incised, as in the other species.

Diameter of centrum,	anteroposterior	.015
	transverse	.0125
	vertical	.0120
Length of diapophysis above		.009
Diameter of diapophysis	vertical	.008
	anteroposterior	.005

The dorsal vertebræ exhibits a longer and more slender diapophysis whose base is vertically expanded, and with a shallow fossa before and behind. The superior half of the diapophysis has a much greater anteroposterior extent than the inferior. There is no recurved rim of the articular extremities, but the surface does not pass regularly into the foramen chordæ dorsalis, but by an abrupt descent at its mouth. The sides of the centrum are concave, and the inferior portion forms a prominent rounded rib.

Diameter of centrum	anteroposterior	.016
	transverse	.015
	vertical	.016
Length of diapophysis		.009
Width af neural canal		.0065

CRICOTUS HETEROCLITUS Cope, Proceed. Acad. Phila. 1876, p. 405.

GENERAL OBSERVATIONS.

After an examination of the first fossils from this fauna which came under my observation, I left the question undecided as to whether its characters pointed to the Triassic or to Permian age. The *Reptilia* and a *Ceratodus* pointed to the former; the *Diplodus* pointed even to the coal measures. The additional evidence adduced in this paper, adds weight to both sides of the question. Of the fishes added, *Ctenodus* is a genus of the coal measures, and while *Strigilina* is new, its affinities are to the Petalodont genera of that formation. On the other hand the reptilian character of *Clepsydrops* is established, and the number of its species increased. Now the coal measures have nowhere disclosed reptilian remains, so far as we have determinations of a reliable character; *Batrachia* were the only type of air breathing vertebrata known to that epoch. The present fauna must then be placed above the coal measures, and the horizon will correspond more nearly with the Permian than with any other embraced in the system.

From its most characteristic fossil, the bed might be called the *Clepsydrops* shale. Its position, according to Dr. J. C. Winslow, is near the top of the Coal Measures, and it is marked No. 15, in Prof. F. H. Bradley's section of the Coal Measures of Vermillion Co., in the Report of the Geological Survey of Illinois by A. H. Worthen, Vol. IV, p. 245. It is about one hundred and eleven feet, averaging different localities, from the summit of the series, and 2099½ feet from the base. Two insignificant beds of coal occur above it, and the following genera of invertebrate fossils: *Productus, Spirifer, Athyris, Terebratula, Hemipronites, Retzia, Zeacrinus, Cyathaxonia, Discina, Lingula, Cardiomorpha, Orthoceras* and *Nautilus*. Several of these genera are found in the Zechstein, while others belong to the Coal Measures and below them.

On some new and little known Reptiles and Fishes from the Austroriparian Region.

By E. D. Cope.

(*Read before the American Philosophical Society, May* 20, 1877.)

A number of interesting points in the distribution of our reptiles and fishes come to light from time to time, which serve to define with more precision the districts into which the Nearctic Realm is naturally divided.* The result of several of these, is to extend over the entire Austroriparian Region the range of several species heretofore supposed to be confined to portions of that district only. A collection formed at Kinston in Eastern North Carolina, in the North-eastern portion of the region in question, by my friend, J. W. Milner, of the United States Fish Commission, is of considerable interest on this account. He found at that point the following species, which had not been previously known to occur east of Georgia or South Carolina :—Batrachia : *Manculus quadridigitatus, Bufo quercicus, Engystoma carolinense.* Reptilia: *Oligosoma laterale, Abastor erythrogrammus.* To this it may be added that Stephen G. Worth recently obtained near Fayetteville, North Carolina, the *Bascanium flagelliforme*, and the true *Hyla delitescens* of Holbrook. I here mention also that several years ago Dr. J. E. Holbrook sent me just before his death a colored drawing of a *Hyla* from S. E. Georgia, made by his friend Dr. Harden, which is probably the *H. carolinensis*, but which differs from the typical form of that species in having a white triangle on top of the muzzle, covering the space between its apex and a line connecting the anterior parts of the orbits, as in the *H. leucophyllata.* A specimen representing a variety of *Eumeces anthracinus* Baird, was sent me from Mobile by Dr. Jos. Corson.

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* See Bulletin No. 1 of the National Museum; Check List of North American Batrachia and Reptilia.

The researches of the distinguished ornithologist, Robert Ridgeway, into the natural history of South-eastern Illinois, have been followed by the same results as those of Mr. Milner in North Carolina. Mr. Ridgway has found in the Wabash valley as far North as Mount Carmel, Illinois, the following species : *Ancistrodon piscivorus, Carphophiops vermis, Haldea striatula, Abastor erythyogrammus, Farancia abacura, Coluber obsoletus confinis* and *Tropidonotus sipedon woodhousei.*

In a considerable collection from Volusia, Florida, several rare species occur. I give the entire list.

BATRACHIA.

Siren lacertina, L.
Pseudobranchus striatus, Lec.
Amphiuma means, Gard.
Engystoma carolinense, Daud.
Acris gryllus, Lec.
Hyla gratiosa, Lec.
" *carolinensis*, Daud.
" *femoralis*, Daud., very common.
Rana halecina Kaln.

REPTILIA.

Crotalus adamanteus, Beauv.
Caudisona miliaria, L.
Ancistrodon piscivorus, Latr.
Heterodon platyrhinus, Latr.
Tropidonotus fasciatus, L.
Eutænia sackenii, Kenn., very common.
" *sirtalis*, L.
Storeria occipitomaculata, Holbr.
Coluber quadrivittatus, Say.
Spilotes corais erebennus, Cope.
Bascanium constrictor, L.
" *flagelliforme*, Catesb.
Cyclophis æstivus, L., abundant.
Pityophis melanoleucus, Holbr.

Dromicus flavilatus, Cope. The second specimen of this very rare species, comes from Volusia. The first was found by Dr. H. C. Yarrow, near Fort Macon, North Carolina.

Osceola elapsoidea, Holbr.

Contia pygæa, Cope. So far as yet known, found only near Volusia.

Cemophora coccinea, Blum., common.

Tantilla coronata, B. & G.

Rhineura floridana, Baird, abundant.

Oligosoma laterale, Say.

Eumeces striatus, L.

Cnemidophorus sexlineatus, Say.

Sceloporus undulatus, Harl.

Anolis principalis, L.

Alligator mississippiensis.

A collection of fishes from the same locality includes a number of interesting species, as follows:

Notemigonus ischanus, Jordan, Check List Fishes Fresh W., N. A. p. 155. A specimen eight inches in length with bright red dorsal, caudal and anal fins.

Arius ?equestris, Baird and Girard, U. S. and Mexican Boundary Surv. II p. 32.

Fine specimens of a species distinct from those of any other country from near Bayport, West Florida, agree in most of the characters cited by the above named authors. Their type was a young fish I suppose, in which the helmet had no such development as in my specimens; its beards are also rather longer.

Chirostoma beryllinum Cope, Trans. Amer. Phil. Soc. 1866, p. 403.

Prof. Jordan states that he has this fish from the St. John's R., Florida.

Haplochilus melanops Cope, Proc. Am. Philos. Soc. 1870, p. 457.

Chænobryttus gulosus C. V. *Centrarchus* C. V.

Radii; D. X-10; A. III-9. Depth of body entering total length 2.75 times.

Enneacanthus fasciatus Holbr. *Bryttus fasciatus* Holbr. Journ. Acad. Phila. 1855, p. 51, Pl. 5, fig. 3.

Char. specif. General form elongate, as in some of the *Chænobrytti*. The depth enters the total length with caudal fin, 3.2 times, and the length of the head enters the same 3.4 times. The diameter of the eye is twice as long as the muzzle, and enters the head 3.2 times, and exceeds the interorbital width. The extremity of the maxillary bone marks the line of the anterior fourth of the orbit. The profile is a gentle convexity from the base of the first dorsal ray. Scales 6–34–13; four rows below the eye on the preoperculum; opercle scaled.

Color a rich brown, with numerous vertical darker bars descending from the base of the dorsal fin. Scales below the middle of the sides each with a brown dot; fins dusky, the dorsal and caudal with pellucid dots. Superior angle of the operculum with a black spot without border, no radii on the cheek ; nose black.

Total length	.055
Length to dorsal fin (axial)	.016
Length to anal fin (axial)	.025
Length to caudal fin (axial)	.044

Lepomis auritus Linn Jordan. *Ichthelis rubricauda* Holbrook.

Lepomis apiatus sp. nov.

A species of discoid form, possessing a well developed patch of teeth on the palatine bones. The gill rakers, although elongate on the anterior half of the first branchial arch are obtuse at their extremities; they are quite robust, and become shorter on the inferior portion of the arch.

The depth of the body is contained in the total length (with caudal fin) 2.27 times, and the length of the head enters the same 3.3 times. The orbit is as wide as the length of the muzzle, and enters the length of the 4.25 times, and equals the inter-orbital width. The extremity of the maxillary bone reaches the vertical line marking the anterior two-fifths of the orbit.

The dorsal spines are robust and high, and are as long as the soft rays; The caudal fin is slightly emarginate. The ventral reaches the first and the pectoral the second anal spines. Radial formula ; D. X-11 ; A. III-10 ; P. 12. The opercular flap is short. Scale formula 6–44–12 ; six rows on the preoperculum below the eye. Opercle scaly.

Color, brown, dark above, lighter below. Each scale has a black spot at the base forming together longitudinal series ; these are less distinct on the superior half of the sides, and are obsolete in that region in large specimens. The spots are distinct on the opercular scales. Fins and muzzle black. Gill spot black, without border.

	M.
Total length	.168
Length to dorsal fin (axial)	.052
" ventral " "	.052
" anal " "	.082
" caudal " "	.140

The external series of teeth are relatively larger in this species than in the *L. auritus* and *L. mystacalis*. No teeth on the tongue.

Lepomis mystacalis, sp. nov.

In this species the gill rakers are of the character indicated by Prof. Jordan as characteristic of the genus *Lepomis*, that is, slender and acute. This species also differs from the *L. apiatus* in the greater compression, and the shorter muzzle.

The greatest depth enters the total length (including caudal fin) 2.5 times, and the length of the head enters the same 4.4 times. The orbit is large, exceeding the length of the muzzle, equaling the interorbital space, and entering the length of the head 3.3 times. Radial formula ; D. X–12 ; A. III–12 ; P. 12. The dorsal spines are robust, but a little shorter than the soft rays; the ventral fin reaches the first spine, and the pectoral the first soft ray of the anal fin. Caudal well notched. The maxillary extends a little beyond the anterior border of the orbit. Scale formula 7–51–15; four preopercular rows below orbit.

Color above dusky, sides silvery, with numerous short undulate vertical brown bars irregularly disposed. Opercular black spot short, without border; the dusky of the face is abruptly arrested by a pale band which extends backwards from the mouth to the preoperculum. A dark line from the chin bounds this below, and defines another silvery band which passes along the mandible, the interopercle and subopercle; cheeks, thorax, and posterior parts of the dorsal, caudal and anal fins yellow.

Xystroplites longimanus, gen. et. sp. nov.

Char. Gen. Inferior pharyngeal bones wide and robust, and paved with truncate grinding teeth. The gill rakers of the anterior half of the first branchial arch elongate; those of the posterior half and of the remaining gill arches, very short and obtuse. No supernumerary maxillary bone; operculum with a produced, entire superior posterior angle. No teeth on the tongue. Spines X. III.

This genus which has been just published by Prof. D. S. Jordan,[*] combines the grinding type of pharnygeal teeth characteristic of *Pomotis*, with the slender gill rakers recently shown by Prof. Jordan[†] to be characteristic of the genus *Lepomis*.

Char Specif. Body elevated, but the head rather produced, so that the profile is oblique and nearly straight from the base of the dorsal fin. The depth of the body enters the total length 2.5 times, and the length of the head enters the same 3.6 times. The orbit is large, equaling the length of the muzzle, and entering the length of the head four times. The interorbital space is 1.5 times the diameter of the orbit. The muzzle is subconic, and the end of the maxillary bone reaches the line of the anterior margin of the orbit.

The dorsal fin is elevated, the spines equalling the soft rays and not separated from them by a notch. Caudal fin openly notched; ventral not reaching anal; the pectoral very long, reaching the line of the fifth anal soft ray. Formula; D. X–12; A. III–11; P. 13. Scale formula 7–44–15; five rows on the preoperculum below the orbit.

The color above is dusky, below silvery, the gular and thoracic region light yellow. The opercular black spot is short, and has a crimson border. Fins black, the caudal, anal and pectoral fins with yellow rays.

Total length	.170
Length to dorsal fin (axial)	.047
" ventral " "	.053
" anal " "	.081
" caudal " "	.131

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[*] Prof. Jordan defined this genus in a paper written some time before this one, and which is probably already printed.

[†] Proceedings Academy, Philadelphia 1877, p. 76.

This fish has a superficial resemblance to the *Lepomis mystacalis.* The ends of the long gill-rakers are obtuse, as in the *L. apiatus.* There are no palatine teeth. It resembles also in form and coloration the *Pomotis microlophus,* Gthr. (*P. speciosus,* Holbr.) from the St. John's River, Florida, a species which I have not seen. According to Dr. Holbrook's figures and descriptions, there is a material difference in the radial formula which is, D. X .10; A. III .9. The form of the dorsal fin is also very different, the second being the higher, and separated from the first by a deep notch, which leaves one spine with the soft rays.

I have this species from near Volusia, and also from near Bayport on the West Coast.

Achirus mollis, De Kay.

Radii, D. 48; A. 35. Length without caudal fin .078; depth of body .042.

CONTRIBUTIONS FROM THE LABORATORY OF THE UNIVERSITY OF PENNSYLVANIA.

No. X.

Dichlorsalicylic Acid.

By Edgar F. Smith, Ph. D.,

Assistant in Analytical Chemistry, University of Pennsylvania.

(*Read before the American Philosophical Society, June* 15, 1877.)

As early as 1845, Cahours (Annalen der Chemie und Pharmacie—52. pp. 340 and 341) described a di-chlor acid which he obtained about the same time he was investigating the di-bromine substitution products of salicylic acid.

The course he pursued to produce the compound was to treat an aqueous solution of salicylic acid with an excess of chlorine. According to his description the acid thus obtained possesses great stability and can very readily be obtained pure.

And again by allowing a slow current of chlorine gas to stream through a dilute solution of potassium salicylate potassium dichlorsalicylate was formed. This salt after repeated recrystallization was obtained in almost colorless needles.

The acid corresponding to this salt was precipitated in white masses upon the addition of dilute hydrochloric acid to a solution of the latter. The acid is soluble in boiling alcohol, from which upon cooling, it separates in needles. Well formed octahedral crystals were secured by allowing a rather dilute solution to evaporate slowly in the air. Boiling water dissolves but small quantities of this acid, which separate out again in very fine needles when the solution becomes cool. Boiling concentrated nitric acid dissolves the compound, and when the liquid cools, beautiful yellow-plates separate out. By distilling the acid with barium oxide dichlorphenol (Acide Chlorophénèsique) was produced, with liberation of carbon dioxide.

Recently, Rogers (Inaugural Dissertation, Göttingen, 1875) published the results of an investigation upon a similar acid. By conducting a calculated amount of chlorine gas into a solution of salicylic acid in glacial acetic acid, and applying heat, he produced dichlorsalicylic acid, which crystallized from the above solution in small white needles. The acid was purified by converting it into its barium salt, and this then recrystallized. The acid from the purified salt fused at 224°C. It was entirely insoluble in cold, soluble in an excess of hot water and very soluble in hot alcohol.

The following salts were made and analyzed :

Dichlorsalicylate of Barium.—$(C_6\ H_2\ Cl_2\ OH\ COO)_2\ Ba + 5\ H_2O$. Long needles, colored slightly brown.

Dichlorsalicylate of Potassium.—$C_6\ H_2\ Cl_2\ OH.\ C\ O\ O\ K$. Showed a tendency to crystallize in small white needles, which lost, by exposure to the air, any water of crystallization they may have possessed.

Dichlorsalicylate of Copper.—$(C_6\ H_2\ Cl_2\ OH\ C\ O\ O)_2\ Cu$. Green, insoluble precipitate.

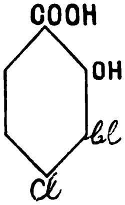
Some time ago I had occasion to make dichlorsalicylic acid, but as I obtained a compound not corresponding to any known analogous derivative, I submit to the Society the following results of my investigation upon the new dichlorine product.

FORMATION OF DICHLORSALICYLIC ACID.

About 40 Grm. of pure salicylic acid (fusing point 156°C) were placed in a flask and upon this was poured a rather large quantity of concentrated acetic acid. While applying a gentle heat to effect solution, a calculated amount of dried chlorine gas was introduced into the liquid, which gradually assumed a deep yellow color. Without waiting for the new acid to crystallize out I added to the yet warm solution a large quantity of water, whereupon the dichlorsalicylic acid fell out in large white flocks. The liquid was filtered off and the acid washed with cold water and then boiled with an excess of barium carbonate. The salt thus obtained was redissolved and recrystallized until it was obtained in almost colorless needles, which crystallize in aggregated masses from an aqueous solution. Upon several occasions monochlorsalicylate of barium was produced, but as this salt is much more soluble than the corresponding compound of the dichlor acid it was easily removed.

Properties—The dichlor acid separates in large flocculent masses upon the addition of dilute hydrochloric acid to a solution of the barium salt. Cold water does not dissolve the acid, an excess of boiling water being necessary to effect its solution. After many recrystallizations the acid fused at 212°–214°C. It separates from an aqueous solution in white arborescent masses. In cold alcohol it is very soluble. By the slow evaporation of such a solution stellated masses consisting of large colorless needles were obtained. The fusing point of these was the same as that of the white crystals. The acid is sublimable with partial decomposition. A drop of ferric chloride added to its aqueous solution imparts to the latter a beautiful violet coloration.

The acid is very probably Parachlormetachlor-ortho-oxybenzoic acid and may be graphically represented as follows:



A combustion was made of the barium salt.

Carbon and Hydrogen Determination. 0.2092 Grm. barium salt dried at 180°C for several hours were burned with coarse and fine lead chromate, and gave 0.241 Grm. CO_2=.065 Grm. carbon = 30.9%C. Farther .012 Grm. H_2O=0.57% H.

SALTS.

DICHLORSALICYLATE OF BARIUM.

$$(C_6H_2Cl_2OHCOO)_2Ba+3\tfrac{1}{2}H_2O.$$

This salt was produced by boiling the free acid with an excess of barium carbonate. Boiling water dissolves it very readily. In cold water it is insoluble. From an aqueous solution it crystallizes in large, almost colorless needles, which are usually combined to aggregated masses.

Water Estimation.

0.6026 Grm. air-dried salt lost upon being heated for three hours at 180° C .0623 Grm. H_2O=10.34% H_2O.

The calculated percentage of water for 3½ molecules equals 10.29%.

Calculated.		Found.
$(C_6H_2Cl_2OHCOO)_2Ba$	=551=89.71%.	
$+3\frac{1}{2}H_2O$	= 63=10.29%.	10.34
	614=100.00%.	

Barium Estimation.

I. 0.5403 Grm. anhydrous salt were placed in a platinum crucible, a few drops of sulphuric acid then added, and this then evaporated to dryness. 0.2227 Grm. barium sulphate were obtained, corresponding to 0.1309 Grm. barium=24.16% Ba.

II. 0.6075 Grm. anhydrous salt gave 0.2550 Grm. barium sulphate, equaling 0.1499 Grm. barium=24.67% Ba.

Calculated %.	Found %.
C_{14}=168=30.60	30.90
H_6= 6= 1.09	.57
O_6= 96=18.60	
Cl_4=142=25.86	
Ba=137=24.95	24.16 and 24.67

DICHLORSALICYLATE OF POTASSIUM.

$C_6 H_2 Cl_2 OH COOK.$

This salt was obtained by boiling the preceding compound with a calculated amount of potassium carbonate. From a concentrated aqueous solution it crystallized in white needles, very much like the salt of Rogers described above. After recrystallizing the compound several times and then allowing it to separate from a dilute solution I obtained it in almost colorless needles, that united to form clusters.

Analysis proved it to be anhydrous.

Potassium Estimation.

I. 0. 2020 Grm. well dried salt gave 0.0710 Grm. potassium sulphate= .03181 K=15.75% K.

II. .2651 Grm. dried salt gave .0930 Grm. potassium sulphate=0.04117 Grm. K=15.5% K.

Calculated %.	Found %
$C_6 H_2 Cl_2 OH COO = 206 = 84.05\%$	
$+ \quad K = 39.1 = 15.95\%$	15.75% and 15.5%
$245.1 = 100.00$	

DICHLORSALICYLATE OF SODIUM.

$C_6 H_2 Cl_2 OH COO Na.$

Obtained by boiling an aqueous solution of the barium salt with sodium carbonate and concentrating the filtered liquid. The salt crystallizes in broad needles, possessing a slight yellow tinge. It is easily soluble in water.

Sodium Estimation.

0.1601 Grm. dried salt gave 0.0530 Grm. sodium sulphate=.0171 Grm. sodium=10.68% Na.

Calculated %.	Found %.
$C_6 H_2 Cl_2 OH COO = 207 = 89.95\%$	
$+ \quad Na = 23 = 10.05\%$	10.68%
$229 = 10000\%$	

DICHLORSALICYLATE OF MAGNESIUM.

$(C_6 H_2 Cl_2 OH COO)_2 Mg.$

An aqueous solution of the free acid was boiled with magnesium carbonate and the liquid evaporated to a small bulk. After standing some time, small, white crystals appeared; these were very readily dissolved by water.

Magnesium Estimation.

.1140 Grm. dried salt gave .0304 $Mg_2 P_2 O_7$=.0064 Grm. Mg=5.61% Mg.

Calculated %.	Found %.
$(C_6 H_2 Cl_2 OH COO)2 = 412 = 94.50\%$	
$+ \quad Mg = 24 = 5.50\%$	5 61%
$436 = 100.00$	

DICHLORSALICYLATE OF LEAD.

$C_6 H_2 Cl_2 O Pb C O O.$

Lead acetate was added to a solution of the ammonium salt and the lead salt obtained as a white insoluble precipitate, which after being well washed and dried was analyzed.

Lead Estimation.

0.1075 grm. dried salt gave .0548 grm. lead = 50. 9 % Pb.

Calulated %.	Found %
$C_6 H_2 Cl_2 O.\ C O O = 205 = 49.76\ \%$	
$+ Pb = 207 = 50.24\ \%$	50. 9 %
$412 = 100.00\ \%$	

Copper Salt.—Small brown crystals soluble in water.

Silver Salt.—White insoluble powder. Decomposed when boiled with water.

ACTION OF NITRIC ACID UPON DICHLORSALICYLIC ACID.

Dilute nitric acid has no effect upon the acid. When treated with fuming nitric acid no change is produced until heat has been applied. After dissolving the dichlor acid in this solvent I permitted the solution to stand several days, hoping to find the nitro compound separated out by that time—this, however, did not occur. Upon evaporating the solution to dryness, nothing remained, the substance, whatever it may have been, having been completely volatilized. A second portion of the acid after treatment with fuming, nitric was mixed with a large quantity of water and then distilled. The distillate possessed a yellow color, and after neutralization with potassium carbonate, was strongly evaporated, then placed in a dessicator over sulphuric acid. After standing some time minute globular crystals appeared, but the quantity being so small I was not able to examine them, preferring to defer the investigation of this nitro compound, if such, until larger quantities of the substance can be obtained.

CALCIUM OXIDE AND DICHLORSALICYLIC ACID.

The acid distilled with calcium oxide yielded an almost colorless oil, having a rather pungent odor. The compound was not further examined.

ETHYL DICHLORSALICYLATE.

$C_6 H_2 Cl_2 OH C O O.\quad C_2 H_5.$

The introduction of the ethyl radical was first attempted by heating upon a water bath a small flask containing the silver dichlorsalicylate and ethyl iodide. This, however, failed to produce the desired result.

In a second trial the perfectly dry and pulverized silver salt was placed in a tube of Bohemian glass, an excess of ethyl iodide then added, the tube sealed and heated in an air bath for twelve hours, the temperature not exceeding 135°C. Upon examination a rather large quantity of silver iodide was noticed, and the liquid which before heating was colorless was now of a reddish-brown hue. The tube was opened and its liquid contents poured through a small filter and after washing the silver iodide with alcohol, the filtrate was evaporated upon a water bath. When the liquid had almost approached dryness I observed minute oil globules of a dark color.

The evaporating dish containing these was immediately removed from the water bath and stood in a cool place. In course of a few hours the oil solidified to a dark crystalline mass, which after pressing well between sheets of filter paper, I dissolved in alcohol and after concentration allowed to cool. Beautiful colorless needles separated from the solution. The fusing point was found to be 47°C. Again dissolved and allowed to crystallize the same form of crystals was obtained. The fusing point remained the same.

Carbon and Hydrogen Estimation.

0.2072 Grm. well dried substance, burned with lead chromate gave .3418 Grm. CO_2 45.51 % carbon. And .0808 Grm. $H_2O = 4.30$ % hydrogen.

Calculated %	Found %
$C_9 = 108 = 45.96$ %	45.51 %
$H_8 = 8 = 3.40$ %	4.30 %
$Cl_2 = 78 = 30.21$ %	
$O_3 = 48 = 20.42$ %	

Cahours* obtained a similar compound by the action of chlorine upon ethyl-salicylate. Broad colorless, shining needles. Fusing point not given. Potassium ethyl-dichlorsalicylate.

$$C_6\,H_2\,Cl_2\,OK\,C\,O\,O\,C_2\,H_5.$$

This salt was produced by boiling an alcoholic solution of the ether with potassium carbonate. It crystallizes in fine colorless needles, which frequently are united to bundles. Very soluble in alcohol.

The points of difference between the compounds of Cahours, Rogers and myself are in brief these:

The acid of Cahours is but slightly soluble in boiling water. Soluble in boiling alcohol, crystallizing from this in needles and octahedral crystals, and it forms also an insoluble nitro-derivative.

The acid gotten by me is perfectly soluble in boiling water, and in cold alcohol—crystallizing from the former in arborescent masses and from the latter it separates in large colorless needles. The nitro-derivative, if any, is exceedingly soluble.

The acid of Rogers fuses at 224°C, is soluble in boiling water and boiling alcohol. The barium salt has five molecules of water and the copper salt is a green insoluble precipitate.

The acid obtained by me fuses at 212°–214°C, its barium salt has but three and half molecules of water and the copper salt forms dark brown warty crystals, soluble in boiling water.

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* Annalen d. Chemie u. Phar. 73. 313.

Discovery of Oxygen in the Sun by Photography, and a new Theory of the Solar Spectrum.

By Professor Henry Draper, M. D.

(*Read before the American Philosophical Society, July* 20, 1877).

I propose in this preliminary paper to indicate the means by which I have discovered Oxygen and probably Nitrogen in the Sun, and also to present a new view of the constitution of the Solar Spectrum.

Oxygen discloses itself by bright lines or bands in the Solar Spectrum and does not give dark absorption lines like the metals. We must therefore change our theory of the Solar Spectrum and no longer regard it merely as a continuous spectrum with certain rays absorbed by a layer of ignited metallic vapors, but as having also bright lines and bands superposed on the background of continuous spectrum. Such a conception not only opens the way to the discovery of others of the non-metals, sulphur, phosphorus, selenium, chlorine, bromine, iodine, fluorine, carbon, &c., but also may account for some of the so-called dark lines, by regarding them as intervals between bright lines.

It must be distinctly understood that in speaking of the Solar Spectrum here, I do not mean the spectrum of any limited area upon the disc or margin of the Sun, but the spectrum of light from the whole disc. I have not used an image of the Sun upon the slit of the spectroscope, but have employed the beam reflected from the flat mirror of the heliostat without any condenser.

In support of the above assertions the accompanying photograph of the Solar spectrum with a comparison spectrum of Air, and also with some of the lines of Iron and Aluminium is introduced. The photograph itself is absolutely free from handwork or retouching. It is difficult to bring out in a single photograph the best points of these various substances, and I have therefore selected from the collection of original negatives that one which shows the Oxygen coincidences most plainly. There are so many variables among the conditions which conspire for the production of a spectrum that many photographs must be taken to exhaust the best combinations. The pressure of the gas, the strength of the original current, the number of Leyden jars, the separation and nature of the terminals, the number of sparks per minute, and the duration of the interruption in each spark, are examples of these variables.

In the photograph the upper spectrum is that of the Sun, and above it are the wave-lengths of some of the lines to serve as reference numbers. The wave-lengths used in this paper have been taken partly from Angström and partly from my photograph of the diffraction spectrum published in 1872. The lower spectrum is that of the open air Leyden spark, the terminals being one of Iron and the other of Aluminium. I have photographed Oxygen, Nitrogen, Hydrogen and Carbonic Acid as well as other gases in Plücker's tubes and also in an apparatus in which the pressure could be varied, but for the present illustration, the open air spark was, all things considered, best. By other arrangements the Nitrogen lines can readily be made as sharp as the Oxygen are here, and the Iron lines may be increased in number and distinctness. For the metals the electric arc gives the best photographic results, as Lockyer has so well shown, but as my object was only to prove by the Iron lines that the spectra had not shifted laterally past one another, those that are here shown at 4325. 4307. 4271. 4063. 4045. suffice. In the original collodion negative many more can be seen. Below the lower spectrum are the symbols for Oxygen, Nitrogen, Iron and Aluminium.

No close observation is needed to demonstrate to even the most casual observer that the Oxygen lines are found in the Sun as bright lines, while the Iron lines have dark representatives. The bright Iron line at G (4307), on account of the intentional overlapping of the two spectra, can be seen passing up into the dark absorption line in the Sun. At the same time the quadruple Oxygen line between 4345 and 4350 coincides exactly with the bright group in the Solar Spectrum above. This Oxygen group alone is almost sufficient to prove the presence of Oxygen in the Sun, for not only does each of the four components have a representative in the Solar spectrum, but the relative strength and the general aspect of the lines in each case is similar. I do not think that in comparisons of the spectra of the elements and Sun, enough stress has been laid on the general appearance of lines apart from their mere position; in photographic representations this point is very prominent. The fine double line at 4319. 4317. is plainly represented in the Sun. Again there is a remarkable coincidence in the double line at 4190. 4184. The line at 4133 is very distinctly marked. The strongest Oxygen line is the triple one at 4076. 4072. 4069., and here again a fine coincidence is seen though the air spectrum seems proportionately stronger than the solar. But it must be remembered that the Solar spectrum has suffered from the transmission through our atmosphere, and this effect is plainest in the absorption at the ultra-violet and violet regions of the spectrum. From some experiments I made in the Summer of 1873, it appeared that this local absorption is so great, when a maximum thickness of air intervenes, that the exposure necessary to obtain the ultra-violet spectrum at sunset was two hundred times as long as at mid-day. I was at that time seeking for atmospheric lines above H like those at the red end of the spectrum, but it turned out that the absorptive action at the more refrangible end is a progressive enfeebling as if a wedge of neutral tinted glass were being drawn lengthwise along the spectrum towards the less refrangible end.

I shall not attempt at this time to give a complete list of the Oxygen lines with their wave lengths accurately determined, and it will be noticed that some lines in the air spectrum which have bright analogues in the sun are not marked with the symbol of Oxygen. This is because there has not yet been an opportunity to make the necessary detailed comparisons. In order to be certain that a line belongs to Oxygen, I have compared, under various pressures, the spectra of Air, Oxygen, Nitrogen, Carbonic Acid, Carburetted Hydrogen, Hydrogen and Cyanogen. Where these gases were in Plücker's tubes a double series of photographs has been needed, one set taken with, and the other without Leyden jars.

As to the spectrum of Nitrogen and the existence of this element in the sun there is not yet certainty. Nevertheless, even by comparing the diffused Nitrogen lines of this particular photograph, in which Nitrogen has been sacrificed to get the best effect for Oxygen, the character of the evidence appears. The triple band between 4240. 4227. if traced upward into the Sun has approximate representatives. Again at 4041. the same thing is seen, the solar bright line being especially marked. In another photograph the heavy line at 3995. which in this picture is opposite an insufficiently exposed part of the Solar Spectrum shows a comparison band in the Sun.

The reason I did not use air in an exhausted Plücker's tube for the production of a photograph to illustrate this paper, and thus get both Oxygen and Nitrogen lines well defined at the same time, was partly because a brighter light can be obtained with the open air spark on account of the stronger current that can be used. This permits the slit to be more closed and of course gives a sharper picture. Besides the open air spark enabled me to employ an iron terminal, and thus avoid any error arising from accidental displacement of the reference spectrum. In Plücker's tubes with a Leyden spark the Nitrogen lines are as plain as those of Oxygen here. As far as I have seen Oxygen does not exhibit the change in the character of its lines that is so remarkable in Hydrogen under the influence of pressure as shown by Frankland and Lockyer.

The bright lines of Oxygen in the spectrum of the solar disc have not been hitherto perceived probably from the fact that in eye observation bright lines on a less bright background do not make the impression on the mind that dark lines do. When attention is called to their presence they are readily enough seen, even without the aid of a reference spectrum. The photograph, however, brings them into a greater prominence. From purely theoretical considerations derived from terrestrial chemistry, and the nebular hypothesis, the presence of Oxygen in the sun might have been strongly suspected, for this element is currently stated to form eight-ninths of the water of the globe, one-third of the crust of the earth, and one-fifth of the air, and should therefore probably be a large constituent of every member of the solar system. On the other hand the discovery of Oxygen and probably other non-metals in the Sun gives increased strength to the nebular hypothesis, because to many persons the absence of this important group has presented a considerable difficulty.

At first sight it seems rather difficult to believe that an ignited gas in the solar envelope should not be indicated by dark lines in the solar spectrum, and should appear not to act under the law "a gas when ignited absorbs rays of the same refrangibility as those it emits." But in fact the substances hitherto investigated in the sun are really metallic vapors, Hydrogen probably coming under that rule. The non-metals obviously may behave differently. It is easy to speculate on the causes of such behavior, and it may be suggested that the reason of the non-appearance of a dark line may be that the intensity of the light from a great thickness of ignited Oxygen overpowers the effect of the photosphere just as if a person were to look at a candle flame through a yard thickness of ignited sodium vapor he would only see bright sodium lines, and no dark absorption lines. Of course, such an explanation would necessitate the hypothesis that ignited gases such as Oxygen give forth a relatively large proportion of the solar light. In the outburst of *T Coronæ* Huggins showed that Hydrogen could give bright lines on a background of spectrum analogous to that of the Sun.

However all that may be, I have no doubt of the existence of substances other than Oxygen in the Sun which are only indicated by bright lines. Attention may be called to the bright bands near G, from wave lengths 4307 to 4337, which are only partly accounted for by Oxygen. Farther investigation in the direction I have thus far pursued will lead to the discovery of other elements in the Sun, but it is not proper to conceal the principle on which such researches are to be conducted for the sake of personal advantage. It is also probable that this research may furnish the key to the enigma of the D_3 or Helium line, and the 1474 K or Corona line. The case of the D_3 line strengthens the argument in favor of the apparent exemption of certain substances from the common law of the relation of emission and absorption, for while there can be no doubt of the existence of an ignited gas in the chromosphere giving this line, there is no corresponding dark line in the spectrum of the solar disc.

In thus extending the number of elements found in the Sun we also increase the field of inquiry as to the phenomena of dissociation and recomposition. Oxygen especially from its relation to the metals may readily form compounds in the upper regions of the solar atmosphere which can give banded or channeled spectra. This subject requires careful investigation. The diffused and reflected light of the outer corona could be caused by such bodies cooled below the self luminous point.

This research has proved to be more tedious and difficult than would be supposed because so many conditions must conspire to produce a good photograph. There must be a uniform prime moving engine of two horse power, a dynamo-electric machine thoroughly adjusted, a large Ruhmkorff coil with its Foucault break in the best order, a battery of Leyden jars carefully proportioned to the Plücker's tube in use, a heliostat which of course involves clear sunshine, an optical train of slit, prisms, lenses and camera well focussed, and in addition to all this a photographic laboratory in such complete condition that wet sensitive plates can be prepared which will bear an exposure of fifteen minutes and a prolonged development. It has been difficult to keep the Plücker's tubes in order; often before the first exposure of a tube was over the tube was ruined by the strong Leyden sparks. Moreover, to procure tubes of known contents is troublesome. For example, my hydrogen tubes gave a spectrum photograph of fifteen lines of which only three belonged to hydrogen. In order to be sure that none of these were new hydrogen lines it was necessary to try tubes of various makers, to prepare pure hydrogen and employ that, to examine the spectrum of water, and finally to resort to comparison with the Sun.

The object in view in 1873, at the commencement of this research was to secure the means of interpreting the photographs of the spectra of stars and other heavenly bodies obtained with my 28 inch reflector. It soon appeared that the spectra of Nitrogen and other gases in Plücker's tubes could be photographed and at first some pictures of Hydrogen, Carbonic Acid and Nitrogen were made because these gases seemed to be of greatest astronomical importance on account of their relation to stars, nebulæ and comets. Before the subject of comparison spectra of the Sun was carefully examined there was some confusion in the results, but by using Hydrogen the source of these errors was found out.

But in attempting to make a prolonged research in this direction, it soon appeared that it was essential to be able to control the electrical current with precision both as to quantity and intensity, and moreover, to have currents which when once adjusted would remain constant for hours together. These conditions are almost impossible to attain with any form of battery, but on the contrary are readily satisfied by dynamo-electric machines. Accordingly, I sought for a suitable dynamo-electric machine and motor to drive it, and after many delays procured a combination which is entirely satisfactory. I must here acknowledge my obligations for the successful issue of this search to Professor George F. Barker, who was the first person in America to procure a Gramme machine. He was also the first to use a Brayton engine to drive a Gramme.

The dynamo-electric machine selected is one of Gramme's patent, made in Paris, and is a double light machine, that is it has two sets of brushes, and is wound with wire of such a size as to give a current of sufficient intensity for my purposes. It is nominally a 350 candle light machine, but the current varies in proportion to the rate of rotation, and I have also modified it by changing the interior connections. The machine can produce as a maximum a light equal to 500 standard candles, or by slowing the rotation of the bobbin the current may be made as feeble as that of the weakest battery. In practical use it is sometimes doing the work of more than 50 large Grove nitric acid cells, and sometimes the work of a single Smee.

The Gramme machine could not be used to work an induction coil when it first reached me, because when the whole current was sent through the Foucault interruptor of the Ruhmkorff coil, making 1000 breaks per minute, the electro-magnets of the Gramme did not become sufficiently magnetized to give an appreciable current. But by dividing the current so that one pair of the metallic brushes, which collect from the revolving bobbin, supplied the electro-magnets, the other pair could be used for exterior work, no matter whether interrupted or constant. The current obtained in this way from one pair of brushes when the Gramme bobbin is making 1200 revolutions per minute is equal to 100 candles, and is greater in quantity and intensity than one would like to send through a valuable induction coil. I usually run the bobbin at 622 revolutions per minute, and this rate will readily give 1000 ten-inch sparks per minute with the 18 inch coil. Of course a Plücker's tube lights up very vividly and generally, in order to get the maximum effect I arrange the current so that the aluminium terminals are on the point of melting. The glass, particularly in the capillary part often gets so hot as to char paper. The general appearance of the machine is shown in Fig. 1.

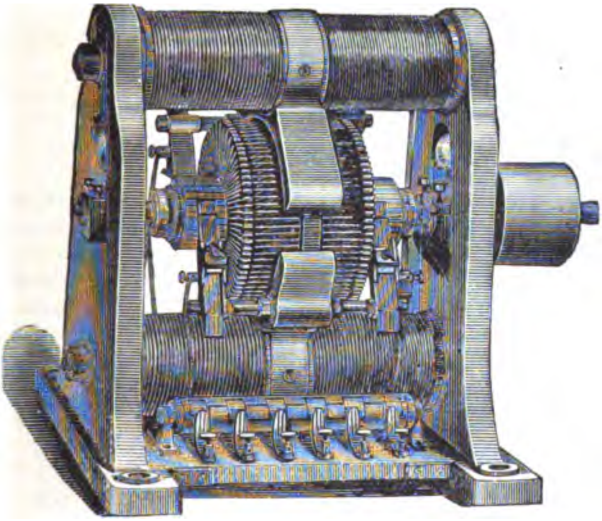


FIG. 1.—THE GRAMME MACHINE.

As long as the Gramme bobbin is driven at a steady rate the current seems to be perfectly constant, but variations of speed make marked differences in the current and this is especially to be avoided when one is so near the limit of endurance of Plücker's tubes. A reliable and constant motor is therefore of prime importance for these purposes. A difference of one per cent. in the speed of the engine sometimes cannot be tolerated, and yet at another time, one must have the power of increasing and diminishing the rate through wide limits. The only motor, among many I have examined and tried, that is perfectly satisfactory, is Brayton's Petroleum Ready Motor.

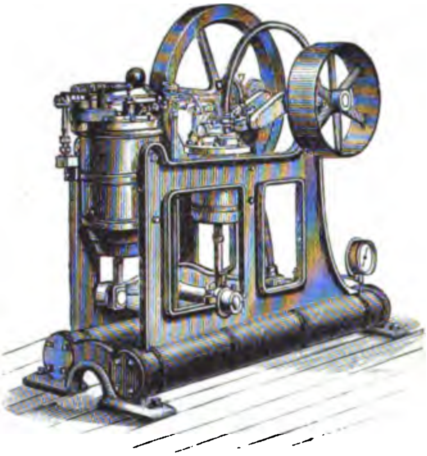


Fig. 2.—Brayton's Petroleum Motor.

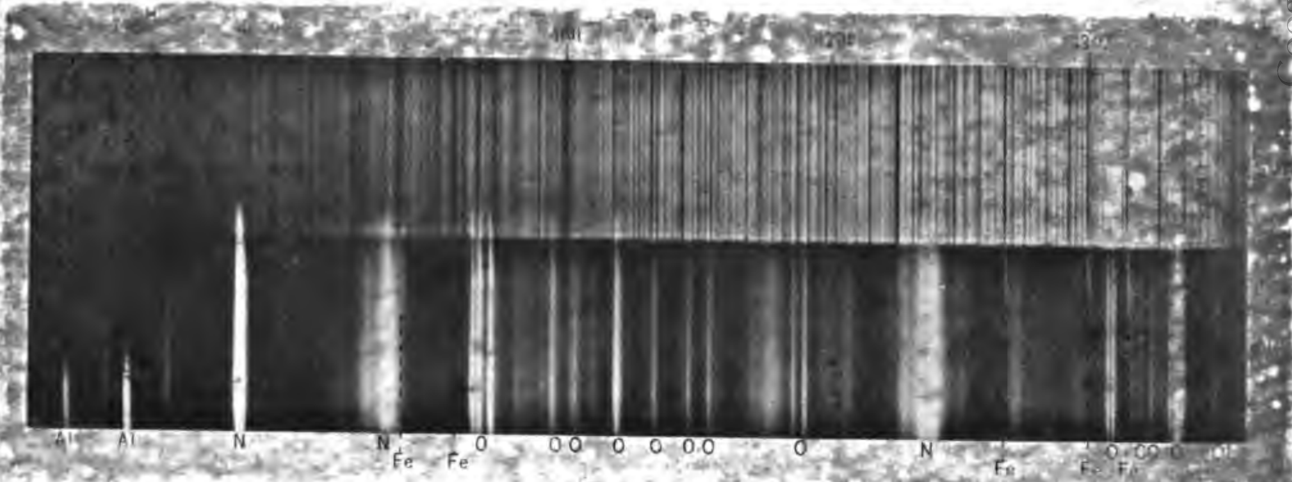
This remarkable and admirable engine acts like an instrument of precision. It can be started with a match and comes to its regular speed in less than a minute; it preserves its rate entirely unchanged for hours together. Moreover, it is economical, cleanly, and not more noisy than a steam engine. The one of two horse power I have, ran for six months, day and night, supplying water and air to the aquaria in the Centennial Exhibition at Philadelphia. At any time on going into the laboratory it can be started in a few seconds even though it has not been running for days.

Henry Draper's Observatory,
Hastings-on-Hudson, New York.

Note on the Exactitude of the French Normal Fork; a Reply to the paper of Mr. A. J. Ellis; by Rudolph König, Ph. D.

(*Communicated by Professor Barker to the American Philosophical Society, July* 20, 1877.)

An attack, as strange as it was unexpected, has just been made in England upon the exactitude of the official French fork. Mr. Alexander J. Ellis, having found that the notes of a tonometer, composed of sixty-five harmonium reeds, constructed by Mr. Appunn, do not agree with this fork, has considered himself entitled to assert, in a paper published in the Journal of the Society of Arts (May 25, 1877), and in Nature (May 31, 1877) that the normal French fork La$_3$ gives, not 870 single vibrations, as has been hitherto supposed, but 878 single vibrations. Mr. Ellis, having established the further fact that the forks constructed by me are in perfect



DISCOVERY OF OXYGEN IN THE SUN BY PHOTOGRAPHY, BY PROFESSOR HENRY DRAPER, M. D. 1876.

The upper part of the photograph is the spectrum of the Sun, the lower part is the spectrum of the Oxygen and Nitrogen of Air. The letters and figures on the margin are printed with type on the negative; with this exception the photograph is absolutely free from hand work or retouching. O. indicates Oxygen, N. Nitrogen, Fe. Iron, Al. Aluminium. The figures above the Sun's spectrum are wave-lengths; G. h, H., are prominent Solar lines at the violet end of the spectrum. The principal point to examine is the coincidence of the bright Oxygen lines with bright lines in the Solar spectrum. The picture is printed from Draper's original negative by Bierstadt's Albertype process.

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accord with the French La_3, does not hesitate to affirm that all these forks, including those even of my large tonometer, which he has probably never examined, are necessarily inexact. Not having at my disposal the instrument used by Mr. Ellis, I confess that I find myself under some embarassment in stating at once by what error of construction this instrument, in the hands of Mr. Ellis, has given results so extraordinary. Fortunately, I can refer to a letter from M. Helmholtz addressed to Mr. Appunn and published by the latter himself in a paper on the acoustic theories of M. Helmholtz. This letter speaks of an instrument of exactly the same character, and made by the same maker, and sufficiently explains the surprising discoveries of Mr. Ellis. "I have examined your tonometer several times," writes M. Helmholtz to Mr. Appunn, "and I am astonished at the constancy of its indications. I would not have believed that reeds could give sounds so constant as those given by your apparatus, thanks to your method of regulating the current of air. The instrument, it is true, varies a little with the temperature, as do also forks; and hence it can be used for determining the absolute number of vibrations, only when one can work in a room heated by a stove. By the aid of an astronomical chronometer, I have counted the beats, and believe that your seconds pendulum must have been slightly inexact, because, though the number of beats agree very well among themselves, the absolute number obtained is not 240 but 237 to the minute. The temperature, which was rather low during my experiments, may count for something; but even this influence may be eliminated by counting the beats to the end of a major-third, which took me a quarter of an hour. In this way I have found for my Paris fork 435.01 vibrations, which agrees to the $\frac{1}{10000}$ nearly with the official number, 435 vibrations."

This letter proves that the entire number of beats in the octave of the tonometer tested by M. Helmholtz was $\frac{237}{60} \times 64 = 252.8$, and that its fundamental note was 505.6 single vibrations instead of 512. On comparing this note of 505.6 single vibrations with a fork giving actually 512 single vibrations, Mr. Ellis would find the latter to be 6.4 single vibrations more acute and, without doubt, would consider it as giving 518.4 single vibrations. Now for my forks giving 512 single vibrations, he has found 516.7 only, with the tonometer which he used. Whence it would seem that the fundamental note of this latter instrument had become more nearly exact than that of the tonometer examined by M. Helmholtz, since the number of its vibrations is 507.3. This note, however, still remains quite distant from its true value.

The fact that M. Helmholtz succeeded, with an instrument of this sort (and one too, even less perfect than that used by Mr. Ellis) in finding the number of vibrations of the official French fork to be exact, by first determining the correction needed for his instrument, is evidence that Mr. Ellis has neglected to determine a similar correction required for his tonometer. He has too hastily declared that these small tonometers with harmonium reeds are the most perfect and the most exact in existence. It would certainly have been much better if he had first given himself a little practice in the manipulation of acoustic instruments, before having treated so slightingly the results obtained by Lissajous, by Despretz, by Helmholtz, by Mayer, etc., etc., and before seeking to throw discredit upon the labors of a *constructeur* who had no reason to expect so unjustifiable an attack.

In addition to Helmholtz's evidence, Professor A. M. Mayer has furnished the following statement concerning the absolute number of vibrations of König's forks. "During the months of March, April and May of 1876, I made many determinations of the number of vibrations of König's UT_3 fork and found that it gave 255.96 complete vibrations in one second at a temperature of 60° Fahr. The following are the separate determinations of that series of which the above number is the mean: (1) 255.95, (2) 255.97, (3) 255.90, (4) 255.92, (5) 256.02, (6) 256.02. The forks vibratory period is accelerated or diminished $\frac{1}{22000}$ part by a difference of temperature of ±1° Fahr."

26 Rue de Pontoise, Paris, June 5th, 1877.

On a New Species of Adocidæ from the Tertiary of Georgia.

By E. D. Cope.

(Read before the American Philosophical Society, July 20, 1877.)

Professor George Little, State Geologist of Georgia, placed in my hands for determination a Chelonite from a Tertiary formation in Macon Co. of that State. The matrix is a rather soft limestone of a light drab color. When the specimen was first obtained it was nearly perfect, lacking only the posterior part of one side, and the posterior border of the carapace. Having been mutilated by destructive curiosity hunters, there remain now the plastron and the anterior half of the carapace, with a considerable portion of the posterior part of the left margin. The surface has been exposed to the weather so as to obscure, and in some places to obliterate the dermal sutures, while the skeletal sutures are distinct. The form has been slightly distorted by lateral pressure, but not much.

The obscurity of the dermal sutures renders the determination of the generic affinities somewhat difficult. The skeleton preserves the Emydoid type, not exhibiting intersternal bones, and having a well developed mesosternum. The vertebral bones extend to between the sixth pair of costals, beyond which the specimen is imperfect in that region. The costal capitula are well developed, but whether they reach the vertebral centra, the specimen does not permit me to discover. The plastron is of peculiar form, the lobes being short and contracted. The anterior is rounded from a base of usual width, while the posterior, from a similar base, narrows rapidly to a point, as in the genus *Aromochelys.*

An important point is observed in the direction of the abdomino-pectoral dermal suture. At its lateral extremities instead of continuing to the marginal scuta as in Emydoid genera, it turns forward and terminates at the inguinal notch, as in genera with intermarginal plates, as *Adocus* and *Dermatemys*. But the sutures of the intermarginals in the specimen are, if they ever existed, very obscure, owing to exposure to the weather. Nevertheless there is sufficient indication of them on one side, to render it tolerably safe to infer their existence. Anterior to the abdomino-pectoral suture, the border of the plastron is crossed by emarginations representing three scutal sutures, defining the humeral, gular, and intergular scuta. The courses of these sutures across the plastron are obscure. The humero-pectoral suture commences on the margin just in front of the axilla and extends forwards parallel with the border, becoming a deep open groove, which is apparent on both sides of the plastron. It then turns backwards, and appears to cross the plastron behind the mesosternum, presenting a concavity forwards. The next suture in front appears to cross near the middle ot the mesosternal bone, presenting a strong concavity forwards. The relation between the intergulars and the gulars is difficult to discover. The suture between them at the free margin is distinct, but after proceeding inwards a short distance it appears to divide and take two directions. One depressed line extends backwards to the humero-gular suture, cutting off triangular gulars and extending the intergulars back to the humerals as in *Adocus*. The other depression extends directly across the anterior lobe, cutting off small intergulars as in *Baëna*. In either case the arrangement represents a genus distinct from either of those named. If the intergulars extend to the humerals they are double, the mesosternal region being divided by a distinct longitudinal dermal suture. If the intergulars are short, with the gulars in contact behind them, the arrangement is equally distinct from *Adocus*. From *Baëna* the absence of intersternal bones, and the Emydoid mesosternum distinguish it. It approaches also *Polythorax*,* and may indeed belong to that genus. But it does not appear that the humerals and interhumerals are distinct in the Georgia turtle, and no intermarginals are observed in *Polythorax*. It is therefore necessary to give the present genus a name to be used until its relations to the latter are positively ascertained. I propose AMPHIEMYS for the genus, and A. OXYSTERNUM as the specific name.

Specific characters. The plastron is nearly plane in the transverse direction; longitudinally the posterior lobe is a little raised above the plane, and the anterior lobe rather more so.

The general form is elevated, the vertical diameter being large when compared with the longitudinal and transverse, which preserve usual proportions. The border of the carapace is not flared at the sides, and rises anteriorly to the nuchal bone. The free anterior margin is somewhat undulate. The anterior half of the carapace does not display any median or lateral keels.

The nuchal bone is considerably wider than long, and the costal and marginal sutures are of about equal length. The vertebrals are all longer than wide, and of the usual form, with truncate antero-lateral angles, excepting the first. This one has both the sides and extremities convex, the latter being of subequal width. The costals are thick, and have parallel borders. The marginals are all higher than long, especially those of the bridge.

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* Cope, Proceed. Acad. Philada. 1876. Nov.

The sutures of the plastron are fine and straight. The portion of the mesosternum enclosed by the episternal or clavicular bones has greater longitudinal extent than the part embraced by the hyosternals. The sutures with the clavicular bone are nearly straight, and are parallel with the free border. The common suture of the hyosternals is a little longer than that of the hyposternals, and is a little shorter than that of the postabdominals. The anterior suture of the latter has a slight posterior obliquity, and is abruptly turned backwards at the free borders of the lobe.

The dermal sutures of the carapace are mostly obliterated. Enough remains to show that the second vertebral was wider than long, while the nuchal shield is considerably narrower than the nuchal bone. The marginal scuta are much narrower than the marginal bones, and become narrower forwards. The region of the nuchal marginal is obscure.

Measurements.	M.
Length of carapace to the posterior border of seventh costal	.250
Depth at third vertebral bone	.150
Length of second vertebral bone	.031
Width “ “ “ “	.032
Thickness “ “ “	.013
Length of first marginal “	.035
Width “ “ “	.033
Length of first do. of the bridge	.028
Width “ “ “ “	.060
Width of second costal	.033
Thickness of “ “	.012
Greatest width of carapace	.182
Length of plastron (axial)	.211
“ “ anterior lobe (axial)	.073
“ “ posterior lobe “	.070
Width of base of anterior lobe	.115
“ “ “ posterior “	.086
Length of bridge	.090
“ “ mesosternum	.042
Width “ “	.046
Length of clavicle	.051
“ “ common suture of clavicles	.014
“ “ “ “ “ hyosternals	.051
“ “ “ “ “ hyposternals	.047
Width of postabdominals at anterior border	.057

The shell of this species is thicker than in any species of tortoise now living in North America, a peculiarity characteristic of most of the species of the Cretaceous period, and of many of those of the Eocene. Its size is about that of the *Pseudemys serrata.*

Tenth Contribution to the Herpetology of Tropical America.

By E. D. Cope.

(*Read before the American Philosophical Society, July* 20, 1877.)

The greater number of the species described in this paper were sent to the Smithsonian Institution by its correspondents, and submitted to my examination by its Secretary, Professor Henry.

Bufo melanochlorus Cope

B. valliceps var. Cope, Journ. Academy, Phila., 1865, p. 100.

Orbital borders elevated, and with parietal branch crests, which are prolonged; toes long, nearly free; end of carpus reaching end of muzzle; paratoids large; a lateral dormal fold; tympanum large; green with deep black spots; throat and thorax black.

This toad differs very much in appearance from the *Bufo valliceps*, but is nearly allied in essentials, its other affinities are to the *B. auritus*. The fingers are quite long, but the posterior legs are short, the heel reaching the posterior border of the orbit. The parietal crest is long; the supratympanic is well developed, and preorbital very weak. The front is not narrower, nor does the muzzle project beyond the mouth. The diameter of the very distinct round tympanic disc is half that of the orbit, which is large. The tongue is long and narrow, and the ostia are only half as large as the rather large choanæ. The parotoids are quite small, sub-triangular and directed outwards and backwards. The skin is nearly smooth above, except on the scapular and iliac regions, and is minutely roughened below. There are two tarsal tubercles, and no tarsal fold. Length of head and body, .047; of head, .015; of hind leg, .070; of hind foot, .030.

The allied *Bufo coniferus* Cope differs from this species in its broadly palmate feet, etc.

East Costa Rica, W. M. Gabb.

Bufo canaliferus Cope.

Orbital border reverted crest-like; a preorbital crest; tympanum distinct; head narrow, muzzle projecting; parotoids large, triangular, with scapular angle; rough; brown with dorsal and lateral light bands.

This handsome species is characterized by the narrow gutter-like front, and prominent muzzle, together with the very large, angulate parotoids. The orbital borders are strongly everted, but without parietal branches. The preorbital crest is not very strong, and the supratympanic is quite short. The muzzle is contracted, and overhangs the mouth. The diameter of the distinct *membranum tympani*, is half that of the orbit. The parotoid reaches to above the middle of the humerus, has a straight external, and convex internal outline, and is rather lateral in position. Its lateral truncation is similar to that seen in *B. hæmatiticus*. The skin is tubercular everywhere, finely so below. The posterior limbs are of median length, the heel reaching to the tympanum. Two rather small tarsal tubercles, no tarsal fold. Soles rough, the palmation measuring the middles of the shorter toes. The tongue is small and narrow; the ostia are a little smaller than the choanæ.

Length of head and body, .054; of head, to posterior line of tympana, 013; width of head at do. .018; length of hind leg, .071; of hind foot, .038.

The color is a light or dark deer brown, with a light vertebral band (rarely absent). On each side of the latter are large brown spots with narrow pale borders. A dark band extends from the orbit to the middle of the side, and above it a broad pale band extends to the groin; inferior surfaces, uniform light yellow.

This species differs from the *B. argillaceus* in its strong cranial crests, projecting muzzle, and large paratoid glands; in the last two characters, and in the narrow front, from the *B. sternosignatus*.

West Tehuantepec, Sumichrast.

HYLA SPILOMMA Cope.

Fingers free; vomerine teeth in transverse series behind line of posterior nares; skin thickened above; tympanum two-fifths eye; frontal bones osseous in front; eye spotted with yellow.

This species is remarkable for the ossification of the anterior portion of the fronto-parietal bones, which are in contact on the middle line near to the ethmoid bone. Posteriorly they are separated, leaving a fontanelle, which represents the posterior portion of the usual one. The species in this respect approximates the genus *Scytopis*.

The head is broad, and the muzzle very short; the canthus are obsolete, and the nostrils a little nearer the end of the muzzle than the orbit. The tongue is wide and entire, and the choanæ small. The palettes are nearly as large as the tympanic disc, and, the toes are quite short, and only about half webbed. The heel of the extended limb only reaches the posterior portion of the orbit.

The superior and lateral integument is thickened and studded on the back with rather large, obtuse, warts. The length of head and body is, .038; of head including tympana, .011; width of head at do., .014; length of hind leg, .052; of hind foot, .023.

The color in these specimens is a light purplish brown, without variations, excepting in one instance. In this one the darker dorsal region is separated from the sides by a broad blackish band which extends from above the tympanum to the groin on each side. The iris is colored in a manner which I do not find in any other species. The pupil appears cruciform, and the interspaces are golden, with a black spot in the outer margin.

This species belongs to the series without webs between the fingers. Among these it is distinguished by the posterior position of the vomerine teeth, moderate tympanum, etc.

From Cosamaloapam Vera Cruz, from Francis Sumichrast.

HYLA BISTINCTA Cope.

Fingers free; vomerine teeth between nares; foot shorter than tibia and femur; tympanum one-fifth diameter of eye; vomerine teeth in small fasciculi; frontal bones ossified in front; blue, sides pale varied; lip not white-bordered.

Size of *Hyla carolinensis*. The head, particularly the interorbital region, is broad and flat; the canthus is distinct; the *membranum tympani* is exceedingly small, and is overhung by a thick dermal fold. The skin of the superior surfaces is smooth. The fore-limbs are very stout, and the animal being a male in breeding condition, the thumb bears two corneous plates on the inner side. The larger of these is the inferior, and forms a strong prominence on the metacarpal. The surface is composed of densely packed points. The posterior limbs are long, the heel reaching nearly to the end of the muzzle. The feet are of moderate proportions, and not fully webbed; the membrane reaches the base of the penultimate phalange of the third and fourth digits, and farther on the fifth.

Length of head and body, .045; of head, .012, width of head at tympana, .015; length of hind leg, .067; of hind foot, .031.

Color, upper surfaces including femur and humerus, dark-bluish plumbeous, without marks; inferior surfaces yellow. Sides marbled with the two colors; posterior face of femur pale brown, with a few yellow specks along the superior border. Eye unspotted.

Vera Cruz most probably; obtained by Dr. Sumichrast with the *H. spilomma* and *H. miotympanum* Cope (= *H. microtis* Peters).

CHOROPHILUS VERRUCOSUS Cope.

The length of the head to the posterior margin of the membranum tympani enters the total length to the vent three and one-sixth times. The head itself is narrow and acuminate, the muzzle projecting acutely beyond the labial margin. The external nares mark two-fifths the distance from the end of the muzzle to the orbital border. The membranum tympani is only one-fourth the diameter of the orbit. The canthus rostralis is distinct, but obtusely rounded. The vomerine fasciculi are approximated, and near the line of the posterior border of the nares, which are larger than the minute *ostia pharyngea*. The tongue is large and wide behind and faintly emarginate.

The heel of the extended hind leg extends to between the orbit and nostril: the femur is short, while the tarsus is long, a little exceeding half the length of the tibia, and exceeding the length of the remainder of the foot, minus the longest toe. The skin of the gular and sternal region is smooth; of the abdomen, areolate. That of the dorsal region is tubercular, smooth warts of large and small size being irregularly crowded over its entire surface, and not at all resembling the areolate surface of the belly.

Color above leaden, with three longitudinal rows of darker, light edged spots, extending, one on each side, and one on the median line. They are each composed of a series of spots joined end to end. Femur and tibia cross-barred. Upper lip dark plumbeous, with a series of five white spots; a similar spot below the tympanum. Inferior surfaces yellowish.

Length of head and body	.019
" " head	.006
" " hind limb	.026
" " femur	.007
" " tibia	.008
" " tarsus	.005
Width of head at tympana	.0055

From Volusia, Florida; Mrs. A. D. Lungren.

This *Chorophilus* is similar in proportions to the *C. triseriatus*, but is well distinguished by the characters of the skin, and the coloration. The tubercular upper surface is quite peculiar, and the smooth gular region is equally wanting to the Northern frog. The dorsal skin is somewhat like that of *Acris gryllus*.

LITHODYTES LANCIFORMIS Cope.

Vomerine teeth in two fasciculi which are truncate posteriorly, and are situated behind the posterior line of the posterior nares. The supraorbital borders not thrown into ridges. Tympanum not narrowed. Heel reaching to extremity of muzzle, when the posterior leg is extended. The head is nearly twice as long as the pelvis.

The head and muzzle are flat, the latter narrowed and convex at the extremity. The canthus rostralis is well defined, and the nostril is nearly terminal. The bones are nearly plane and vertical, and their length to the end of the muzzle is twice the diameter of the eye. The latter is one-third greater than that of the tympanum. The choanæ exceed the ostia in size. There are no dermal folds on the back or inferior surface. The metatarsi are all somewhat separated, and connected by a thin membrane, but this is merely due to the attenuation of the usual solar integument. The hind legs are very long; the pallettes small on the hands, and of median size on the feet.

The color above is dark ashen penetrated with pink; there is a narrow median dorsal white line. A broad black band extends from the end of the muzzle across the tympanum, where it contracts to a narrow black line which extends from the superior border of the tympanum to near the middle of the side. The concealed surfaces of the limbs are uniformly dusky; the femur and tibia are pink with dusky cross-bands. There is a dark interorbital cross-band in front of which the muzzle is very pale. Upper lip without dark spots; below immaculate.

Total length M. .026; of head, .011, or 2.4 of the total. Hind limb, .050.

From the "West Coast of Central America," without more specific locality.

This species is easily distinguished by the great relative length of the head. especially as compared with that of the pelvis.

LITHODYTES PELVICULUS Cope.

Lateral borders of the fronto-parietal bones elevated into longitudinal crests, which on the vertex are abruptly incurved without meeting. Tympanic disc a broad vertical oval, as large as eye; vomerine teeth in short, approximated, transverse, fasciculi, behind the line of the posterior border of nares. Head short, very wide, muzzle not projecting. Heel of extended hind foot reaching to middle of orbit. Gray varied with blackish above and below.

This species resembles nearly the *L. megacephalus* Cope, Journ. Acad. Phila., 1875, p. 100, but differs in a number of points. The first is the much greater size of tympanic disc, whose diameter is only about half that of the orbit in the latter; in the posterior incurvature of the superciliary crests (they are straight in *L. megacephalus*) ; in the much smaller size, the linear dimensions being less than half those of the *L. megacephalus*.

There are two suprascapular longitudinal dermal folds which converge towards the middle line without meeting. Pallettes and tubercles small. Canthus rostralis straight, intercanthal region plane; muzzle a little retreating, nostrils terminal. General color ashen gray; a large black spot below eye, and another above, and on tympanum; muzzle, interorbital, and interscapular regions dusky. Soles and posterior faces of femora black. Concealed faces of hind feet and limbs and abdomen, yellow coarsely reticulated with blackish; throat thickly dusted with the same. A dark band with a pale superior border above each ilium.

The *L. pelviculus* is said to have been found on the west coast of Central America, without more special designation of locality.

PHYLLOBATES CYSTIGNATHOIDES Cope.

This rather small species has the form of the species of *Lithodytes*, as *L. rhodopis* or some of the *Cystignathi*. The muzzle is rather elongate and the front rather convex. The limbs are rather long, and the tubercles on the inferior side of the digits are prominent. The terminal dilations of the toes are of moderate size, and equal on the two limbs.

The apex of the muzzle is narrowed, but rounded, and does not project much beyond the lip. Its distance from the nostril is one-third that between the latter and the orbit. The tympanic disc is very distinct, is subround, and its diameter is one-half that of the orbit. The tongue is pyriform and much narrowed in front. The nares are sublateral, and the *ostia pharyngea* very small. The end of the tarsus extends beyond the muzzle, and the heel marks the middle of the eye. Both tarsal tubercles are distinct. There are strong tubercles along the inferior face of each metatarsal. The skin is everywhere entirely smooth.

Measurements.	M.
Length of head and body	.0225
" " " including tympana	.0075
Width " " at tympana	.0070

	M.
Length of fore limb	.0140
" " " foot	.0050
" " hind limb	.0330
" " " foot	.0155
" " tarsus	.0055
" " tibia	.0100

The color of the upper surfaces is a reddish brown; below, leather brown. The back is thickly spotted with large darker or blackish spots, the largest of which reaches to between the eyes. The sides are marbled with lighter and darker, but the femora are unicolor. Limbs obscurely cross-banded; below uniform, upper lip with a few pale spots.

Numerous specimens of this species were found by Francis Sumichrast at Potrero near Cordova, Vera Cruz, under decayed trunks of trees. It is of more lanciform proportions than the Central American species, *P. hylæformis* and *P. ringens*.

CYSTIGNATHUS LABIALIS Cope.

Vomerine teeth in transverse series behind the posterior border of the internal nares; toes without dermal border; no abdomdinal discoidal fold; posterior limbs short; end of metatarsus just reaching muzzle, muzzle short; not projecting; teeth much behind choanæ; one dermal fold on each side; skin rough; below white.

This small species belongs to that division of the genus, in which the toes do not possess dermal margin, and there is no discoidal fold of the abdominal integument. Among these it is distinguished by the shortness of the series of vomerine teeth and the paucity of dermal plicæ. The muzzle is acuminate and rather narrow, but not projecting as in *C. gracilis;* the canthus is not distinct. The tongue is oval and a little notched behind; the choanæ are small. The diameter of the tympanic disc is one-half that of the orbit. The heel only reaches the orbit. The toes are not very long; there are two small tarsal tubercles, and a narrow tarsal fold.

Color chocolate brown, the limbs darker cross-barred. A brilliant white band extends from the anterior part of the upper lip, and describing a curve upwards, bounds the orbit below and descends to the *canthus oris*, from which point it continues in a straight line to the humerus, and ceases. Inferior surfaces, pure white. Length of head and body, .020; of head, .007; of hind limb, .028; of hind foot, .013.

The precise *habitat* of this species is at present uncertain. It is probably a part of Sumichrast's Mexican collection.

SIPHONOPS PROXIMUS Cope.

Tentacular fossa close to eye; annuli complete; muzzle depressed, elongate, narrow; rings $\frac{0}{27}\frac{83}{83}$ - 19 = 129 or $\frac{0}{28}\frac{74}{74}$ - 27 = 129; longer than *S. mexicanus*.

This Caecilian resembles so much the *S. mexicanus* that I referred specimens of it to that species in my Batrachia and Reptilia of Costa Rica. It possesses the same produced, flattened muzzle, with distinct eye, and the coloration is similar, but the position of the tentacular fossa is quite different, and the general form is more elongate and slender. The diameter is about the same. Length, .425; diameter, .017.

Coast of Eastern Costa Rica; W. M. Gabb.

SIPHONOPS SIMUS Cope.

Tentacular fossa close to eye; annuli complete; muzzle wide, truncate, nostrils terminal; annuli 228; anterior 8 undivided; 22 posterior fully divided by intermediate plicæ.

The form of the head of this species is different from that of any other *Siphonops* of Mexico or Central America, and its annuli are more numerous. They continue to the anus, and those of the principal series are nowhere divided on the middle line. The form is not slender, but is more so than in the *S. mexicanus*, resembling in this respect the *S. proximus*. Length, .308; diameter at middle, .011. Color dark brown; below a little paler.

This species was found in Costa Rica, the exact locality being uncertain. From Dr. von Franzius.

SIPHONOPS OLIGOZONUS Cope.

Tentacular fossa close to eye; many annuli incomplete; muzzle narrow, projecting; eye invisible; nostrils lateral; annuli of principal series 119, of which 14 anterior and 42 posterior are complete; of second series (none in anterior 72 annuli), 34 incomplete and 13 complete.

This Batrachian resembles at first sight the *Caecilia ochrocephala*, as it possesses the same yellowish head and brown plumbeous body. It is abundantly distinct from the other species of the genus in various respects, combining the interrupted annuli of some of the Brazilian species, with a narrower, projecting muzzle, and invisible eye. The annuli continue to the vent, and those of the secondary series commence much posterior to the point of beginning in the other species. Length, 0.263; diameter, .005.

The precise *habitat* of this species is uncertain.

CAECILIA ISTHMICA Cope.

General form robust. Muzzle flat, rather wide, and projecting far beyond the mouth. Tentacular fossa near the edge of the lip a little behind and below the line of the nostril. Eye distinct. Annuli one hundred and forty-two, of which only the last sixteen surround the body, the anterior one hundred and twenty-six being interrupted both on the dorsal and abdominal lines. Between the last seven rings are additional plicæ, which cross the dorsal line and extend on the side, but are not continued across the abdominal line. Length, .570 mm.; diameter (which is about uniform), .020; length to rictus oris, .017. The general color in alcohol is dark brown; the inferior surface is a little paler.

This species was included in the collection made by Commander Selfridge on the East side of the Isthmus of Darien. The species obtained are the following:

Dipsas cenchoa L.
Oxyrrhopus clelia L.
Leptophis occidentalis Gthr.
Herpetodryas carinatus L.
Rhadinæa ignita Cope.
Pliocercus euryzonus Cope.
Ophibolus micropholis Cope.
Nothopsis rugosus Cope.
Ninia atrata Hallow.
Diploglossus monotropis Kuhl.
Anolis laticeps Berth.
Caecilia isthmica Cope.

HELICOPS TRIVITTATUS Cope.

Scales in seventeen longitudinal rows, all keeled excepting the inferior two. The keels are moderately and equally developed throughout the entire length. The last maxillary tooth is not much longer than the others, and it is separated from the penultimate by a space which a little exceeds those between the anterior teeth. The internasal plate is nearly triangular, the rostral is wider than high, and the nasal is as long as wide, and is divided downwards from the uplooking nostril. Loreal twice as high as long; oculars 1–2, the anterior narrow, and well separated from the frontal. Two long large temporals on the external side of each parietal, the anterior occupying the space behind the postoculars. Superior labials eight, the eye resting on the fourth only; the fifth and sixth subequal, the seventh a little larger. Gastrosteges 121; urosteges 78; anal divided.

Color above dark brown, with an indistinct pale vitta on the fifth row of scales, and a yellow vitta on the adjacent halves of the first and second rows. Belly yellow with three longitudinal dark brown bands; the median only preserved on the tail.

Total length, .540; length of head to rictus, .015; of tail, .180.

Habitat unknown, but supposed to be the Argentine Confederation.

OXYRRHOPUS RUSTICUS Cope.

Head but little distinct from the body, front convex, muzzle slightly protuberant. Grooved tooth not much longer than those preceding it. Rostral plate as high as wide, convex and produced backwards above; internasals and prefrontals broader than long. Frontal with longer anterior than lateral borders, superciliaries narrow, parietals short. Nasals large, loreal longer than high, produced backwards to the orbit below the very small preocular, which is widely separated from the frontal. Postoculars two, in contact with one temporal. Temporals 2–3. Superior labials seven, eye resting on third and fourth; fifth higher than long. Eye rather small. Inferior labials nine, the fifth the longest, and in contact with the postgeneial. Geneials equal. Scales equal, rather wide, with double fossæ, and in nineteen rows. Tail short. Gastrosteges 223; urosteges 54; anal entire.

Dark yellowish brown above, the scales indistinctly blackish bordered; below uniform yellow; upper lip yellow.

This *Oxyrrhopus* is distinguished by a robust and obtuse form in a higher degree than its nearest ally the *O. plumbeus*. The form of the rostral plate, peculiar relations of the loreal and preoculars, with the single temporal in contact with the postoculars, short tail, and color serve to distinguish it from that species.

From the same locality as the last. With them were collected the following species.

Hyla vauterii Bibr.
Aporophis anomalus Gthr. (*L. rutilus* Cope).
Dryophylax schottii Fitz.
Dryophylax olfersii Licht.
Opheomorphus merremii Neuw.
Thamnodynastes nattererii Mik.
Herpetodryas carinatus L.

CNEMIDOPHORUS MICROLEPIDOPUS Cope.

A species distinguished by the small size of the scales on the brachium and thigh.

A few rows of large scales on the collar; the edge with much smaller scales; two preoculars and a frenoöcular; three supraorbitals; larger gular scales few and in the centre of the throat; postbrachials numerous, small; brachials in 3, femorals in 14 rows; olive, with eight indistinct pale bands, black between the two inferior.

There are several flat small scuta behind the parietals and interparietals.

There are a few points of coloration to be observed in describing this lizard. There are four yellow spots at the corners of an imaginary square which encloses the tympanic disc. There is another between the antero-superior of these and the orbit, and another below the posterior part of the eye. The inferior yellow line is continued on the tail.

About the size of *C. sexlineatus;* as the median dorsal lines are faint in the single specimen is not probably young.

West Tehuantepec, Sumichrast.

CNEMIDOPHORUS UNICOLOR Cope.

A small species distinguished by the absence of coloration marks.

A few rows of large scales on the collar; the edge with much smaller scales; two preoculars and a frenoöcular; three supraorbitals; larger gular scales few and in the centre of the throat; postbrachials larger, above point joining brachials which are in 5 rows; femorals in 10; olive brown with one pale lateral line; four pale spots below and behind eye.

There are four yellow spots round the tympanic membrane, one below the eye, and one between the latter and the nearest one of the former, as in *C. microlepidopus*. The dorsal scales are minutely roughened. It is in general characters allied to the *C. inornatus* Baird from Northern Mexico. The latter differs in the presence of four supraorbital plates, smaller collar scales, and coarser and rougher dorsal scales.

West Tehuantepec, Sumichrast.

CNEMIDOPHORUS IMMUTABILIS Cope.

This species attains to the largest size known in the genus, without losing its striped coloration, as do the other large forms.

Several rows of large scales on the collar, the border row not larger nor much smaller; two preoculars and a frenoöcular; larger gulars median, three supraorbitals; postbrachials small; brachials in 3, femorals in ten rows; adult with eight longitudinal bands; femora pale spotted.

The small size of the postbrachial and femoral scales, relate this species to the *C. guttatus*, but it lacks the small scales of the border of the fold seen in that lizard. The interparietal in an adult is narrow. The temporal region is covered with minute scales. There are numerous small scuta behind the parietals. There are two rows of antebrachial scuta well defined at the borders. Two rows between the inferior and infralabials. The inferior lateral brown band extends to the orbit. Throat pale; breast plumbeous.

West Tehuantepec, Sumichrast.

CNEMIDOPHORUS LINEATTISSIMUS Cope

This swift lizard is of medium size in the genus, and maintains the lined coloration intact.

Several rows of large scales on the collar, the border row not larger nor much smaller; two preoculars; no frenoöcular; three supraorbitals; larger gulars extending across throat; superior preocular not descending to labials; postbrachials large, continuous with brachials; femorals in eight rows; black, with ten or eleven pale bands; sides and femora pale spotted; throat black.

The muzzle is rather acute but not elongate, and the fronto-nasals have considerable mutual contact. The larger and smaller gulars are abruptly distinguished from each other, and the former are smaller than the scales of the collar. The frenal plates form a circle surrounding a large median scute, of which the two posterior plates are the largest.

There is a space between the two submedian lines, which is often divided by a median line. Below the lowest line the sides are black with large light spots, open below.

Colima, Xantus; Guadalaxara, Major.

CNEMIDOPHORUS LATIVITTIS Cope.

Several rows of large scales on the collar, the border row not larger nor much smaller; two preoculars, the superior not descending; no frenoörbital; supraorbitals 3; larger gulars extending across the throat; post brachials large, continuous; femorals 8 rows; olive, with eight wide bands, ground black between second and third

The nostril is in front of the nasofrenal suture. Parietals and interparietals of normal proportions, surrounded by a series of moderate scales, in a semicircle. One row between the inferior labials and infralabials. Brachials large, in five continuous rows, distinct, no postbrachials. Two rows of antebrachials. Scales of collar equal those of gular region. larger than postgulars, and smaller than abdominals. Femoral pores seventeen.

Color below bluish; pectoral region blackish; there are small yellow spots on the external abdominal scuta and on the femora. A longitudinal yellow line on the posterior face of the femora.

Total length, M. 0.255; length to tympanic drum posteriorly, .020; to vent, .076; length of hind limb, .051; of hind foot, .026.

Tuchitan, Tehuantepec, Sumichrast.

This handsome species is, in the number of its longitudinal stripes, similar to the *C. octolineatus* of Baird. That lizard differs in having four supraorbital plates, and smaller collar scales; the stripes are also much narrower.

CNEMIDOPHORUS COMMUNIS Cope.

This species is near to the *C. sexlineatus* in its characters, but constantly differs in the presence of the frenoörbital plate. It is also much larger, the males equaling the large Amivas.

A few rows of large scales on the collar, of which the marginal is the largest; two preoculars and a frenoöcular; four supraorbitals; large gulars extending across throat; postbrachials and brachials large, continuous; three large preanals; femorals in 8-9 rows; olive, with six light bands with light spots in the intervals, the former breaking into spots in the adult male.

There are two varieties of this lizard. In the first, there are rows of light spots in the spaces between the stripes in the females; while in the males the stripes are broken up into round spots so as to give a coloration like that of the *C. guttatus*. In the second variety there are no spots and the bands are unbroken. The specimens resemble the young of var. 1.

Var. I. Colima, Xantus; Coban, Guatemala, Hague.

Var. II. Guadalaxara, Major; Cordova, Sumichrast; Guatemala, Hague; San Antonio, Texas.

CNEMIDOPHORUS ANGUSTICEPS Cope.

This species is in general characters similar to the last, but it differs in the coloration, and in the very narrow form of the parietal and interparietal plates.

A few rows of large scales on the collar, of which the marginal is the largest; two preoculars and a frenoöcular; four supraorbitals; similar but interparietal and parietal scuta half as wide; ground color black and bands much wider and not broken up in male.

The color stripes of this species if assumed to be those of the paler color, are much wider than the ground, and instead of becoming broken up as in *C. communis*, send off lateral processes, which give the dark ground color a very broken character. The color of the bands is an olive green. The adult male is of about the size of those of *C. communis* and *C. guttatus*.

Yucatan, Schott.

CNEMIDOPHORUS COSTATUS Cope.

In general characters this lizard resembles the last two, but it differs in the shorter head, and strikingly in the coloration.

A few rows of large scales on the collar, of which the marginal is the largest; two preoculars and a frenoöcular; four supraorbitals; similar to *C. communis*, but head shorter and scuta wider; brown with black cross-bands on sides, which join across the middle line on the lumbar region; sacral region and femora white spotted.

The short head of this species is accompanied by an abbreviation of the sutures of mutual contact of the fronto nasal and internasal pairs of scuta, which is not seen in the other allied species. The unique specimen is smaller than the females of the two species last described, yet it presents no trace of stripes. From its coloration I should suppose it to be an adult male.

The locality of this specimen is only stated to be "Mexico."

GERRHONOTIDÆ.

The important variations in the scutellation of the head of the species of this family lead to the view that several genera are indicated. The definitions of these are as clear as those of many genera of the system, and as it appears to me, may be profitably associated with names as elsewhere. There is a tendency to subdivision of the head-shields in some species, it is true, but a little patience in studying the homologies of the portions separated in excess, will refer them to their proper positions and reduce them to the types herein mentioned. Dr. Gray, in 1845, attempted to distinguish four genera among the species of the original genus *Gerrhonotus* of Wiegmann, but the characters he seized upon do not, with one exception, possess the importance he attached to them. The exception is that of *Barissia*, which has maintained its distinctive feature, the absence of the interfrontonasal scutum. Two species recently described by Bocourt exhibit, according to that herpetologist, the equally important feature of the absence of the frontonasal plates. The great subdivision of the plates of the internasal region distinguishes a number of species, one of which was named long since *Pterogasterus* by Messrs. Peale and Green.

PTEROGASTERUS Peale and Green.

Three pairs of internasal scuta; interfrontonasals and frontonasals present.

Species: *P. ventralis* P. & G.; *P. tessellatus* Wiegm.; *P. ophiurus* Cope; *P. infernalis* B. & G.; *P. lemniscatus* Boc.; *P. modestus* Cope, sp. nov.

GERRHONOTUS Wiegmann.

Two pairs of internasals; interfrontonasals and frontonasals present.

Species: *G. multicarinatus* Blv.; *G. grandis* B. & G.; *G. scincicaudus* Skilt.; *G. principis* B. & G.; *G. kingii* Gray; *G. gramineus* Cope; *G. auritus* Cope; *G. tæniatus* Wiegm.; *G. deppei* Wiegm.; *G. formosus* Bd.; *G. vasconcelosii* Boc.; *G. rhombifer* Pet.; *G. monticolus* Cope, sp. nov.

MESASPIS Cope, gen. nov.

Two pairs of internasals; interfrontonasal present; frontonasals wanting.

Species: *M. moreletii* Boc.; *M. fulvus* Boc.

BARISSIA Gray.

Two pairs of internasals; interfrontonasals wanting; frontonasals present.

Species: *B. antauges* Cope; *B. bocourtii* Pet.; *B. lichenigera* Wiegm.; *B. imbricata* Wiegm.; *B. rudicollis* Wiegm.

An extinct genus of the family has been found in the Miocene beds of the White River group of Colorado, which I have called *Peltosaurus*.* The scales in that genus were conjoined by sutural borders and not imbricate, as in the recent genera.

PTEROGASTKRUS MODESTUS, sp. nov.

Scales $\frac{10}{12}$ slightly convex above, but not keeled, excepting those of the tail, which are strongly and obtusely carinate or ribbed; an azygos scute between the two anterior pairs of internasals. Internasals of first pair reaching first labials. Internasals of third pair elongate, in contact with frontonasals behind, apparently including the small lateral interfrontonasals. Two postnasals; a large plate, the anterior canthal, descends to the labials, from the inferior part of which a loreal may be separated. Preoculars two or one. Two pairs of large infralabials in contact, following the symphyseal, without a postmental; two pairs follow, of which the anterior are separated by one scute. Lateral fold extending from ear to vent; the granular area extending above the humerus. Appressed limbs separated by six cross-rows of abdominal scales, or the length of the fore arm. Rows of scales from nape to origin of tail, forty-seven; do. from front of humerus to vent, thirty-eight.

The tail is not very long and is grooved below as well as above. Total length, .150; length to meatus auditorius, .012; to vent, .072; length of hind leg, .019. Color above, brown; below, olivaceous. The sides are a reddish-brown or maroon, bordered above by a blackish line which separates it from the dorsal color.

This species differs from all others of the genus in the extinction of the small plate which truncates the lateral angle of the interfrontonasal. As a consequence of this, the latter has a diamond shape, as it does not reach the frontal plate behind nor the azygos plate in front. The smooth scales also separate it from all others of the genus.

The precise locality from which the specimens of this lizard were sent to the Smithsonian Institution is uncertain, but is probably Guatemala.

GERRHONOTUS MONTICOLUS, sp. nov.

"*Gerrhonotus fulvus* Boc," Cope, Journ. Ac. Phila., 1865, p. 118, nec Bocourtii.

Scales keeled on the middle line of the back, to the number of three or four rows; other dorsal and lateral series smooth; those of the superior surface of the tail keeled strongly. Lateral fold extending from ear to vent; granular scales extending above the humerus. Scales above and below $\frac{15}{12}$; forty-five transverse rows between nape and origin of tail, and thirty-six rows between front of humerus and vent.

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* Annual Report U. S. Geol. Surv. Terrs., 1873, p. 512.

The interfrontonasal is transversely diamond-shaped, and has no external plates at its lateral margins. The frontonasals have considerable mutual contact. There are two postnasals; the anterior (and only) canthal descends to the labials, taking the place of the loreal, and there is one large preocular. A postmental follows the symphyseal, and then one pair of infralabials in contact. Two pairs follow, the anterior interrupted by one, the second by two, scales. The auricular opening is nearly as long as the fissure of the eye. The appressed limbs are separated by the space of four ventral cross-rows, or the length of the longest digit of the manus. The tail is of moderate length.

Color of upper surface and sides, brown, the latter a little darker, and bounded above by a narrow black line. A somewhat irregular row of small black spots down the median dorsal line. Below yellowish olive, the scales of the abdomen with black borders, those of the gular and thoracic regions with black centres.

Total length, M. .143; length to auricular meatus, .012; to axilla, .023; to vent, .061.

From the summit of the Pico Blanco (elevation 11,500 feet) in the Eastern Cordillera of Costa Rica; W. M. Gabb.

This species I provisionally identified with the *G. fulvus* of Bocourt, which has been found in Guatemala. The two species are probably nearly allied, but present a difference in the cephalic scutellation, which is of generic value.

Further Illustrations of Central Force.

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(*Read before the American Philosophical Society, July 20th,* 1877.)

The establishment of centres of oscillation and harmonic nodes, in an elastic medium, is a necessary consequence of the principle that "a system of bodies in motion must be regarded mechanically as a system of forces or powers which is a perfect representation of all the single powers of which the system is compounded, and this, too, at whatever time or times the component powers may have been introduced into the system."*

But since it is often more difficult to grasp truths which are presented under new aspects, than those which are clothed in familiar garbs, it may be well to glance at some of the most obvious tendencies to nodal action, which result from simple gravitating fall towards a centre. The exami-

*Peirce. Proc. A. A. S., ii, 111.

nation will be the more interesting and suggestive, because like tendencies must exist in all central forces which vary inversely as the square of the distance.

Ennis* has called attention to the fact, that the difference between the velocity of infinite radial fall $(\sqrt{2gr})$ and circular-orbital velocity $(\sqrt{gr})$, must be accounted for in some way, and he thinks that it may be sufficient to explain all the phenomena of planetary rotation and revolution. In nebular condensation from r to $\frac{r}{n}$, the increase of radial velocity is $(\sqrt{n} - 1)\sqrt{2gr}$; the circular-orbital velocity at $\frac{r}{n} = \sqrt{ngr}$; therefore the increase of radial velocity would be sufficient to produce orbital velocity in the periphery of a stationary nebula, when $\sqrt{n} = \sqrt{2}\,(\sqrt{n} - 1)$, and $n = \frac{2}{3 - 2\sqrt{2}} = 11.656854$. If r be made to represent, successively, all points between secular aphelion and secular perihelion, in the hypothetical nebulous belts which were condensed into Neptune, Uranus, Saturn and Jupiter, this fall of condensation from Neptune would give orbital velocities in the asteroidal belt; from Uranus, in the Mars belt; from Saturn, in the Venus belt; and from Jupiter, in the Mercury belt. Earth, as I have already shown, is at the centre of the primitive inter-asteroidal belt, which appears to have been then broken up by the action of Uranus, Saturn and Jupiter.

Neptune,	$\div\ n$	=	2.577	Astræa,	=	2.577
Uranus, s. p.,†	$\div\ n$	=	1.517	Mars,	=	1.524
Saturn, s. p.,	$\div\ n$	=	.749	Venus, a.,	=	.749
Jupiter, s. a.,	$\div\ n$	=	.473	Mercury, s. a.,	=	.477

This would leave the orbital velocities of the four outer planets to be accounted for by like condensation from an earlier nebulous condition, of which we have no visible evidence, but if the main hypothesis is correct, we may reasonably look for confirmation of a different kind, within the present limits of the solar system. If we consider the *vis viva* of orbital and radial velocity for unit of mass, the *v. v.* added by radial fall from r to $\frac{r}{m}$ is $(m - 1)\,gr$, while the *v. v.* added by equivalent orbital contraction is only $\frac{1}{2}(m - 1)\,gr$, or one-half of the radial addition. A simple nebular condensation from r to $\frac{r}{2}$ would, therefore, add gr to the *v. v.*, which is equivalent to the *v. v.* of circular-orbital revolution at $\frac{r}{2}$. There is, therefore, a tendency to repeated nebular ruptures at $\frac{r}{2}, \frac{r}{4}, \frac{r}{8} \ldots\ldots \frac{r}{2^m}$.

Starting from the present outer limit of our system, Neptune's secular aphelion (30.46955), these rupturing nodes would occur at 15.23478; 7.61739; 3.80870; 1.90435; .95217; .47608; .23804. The first belt would include Neptune and Uranus; the second, Saturn; the third, Jupiter; the fourth, the asteroids; the fifth, Mars and Earth; the sixth, Venus (grazing also the Earth and Mercury belts); the seventh, Mercury.

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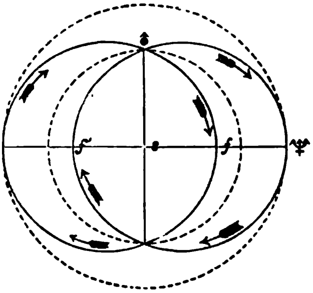
* "Origin of the Stars."

† a., *aphelion;* p., *perihelion;* s., *secular.*

After the nebula had assumed a globular form, these rupturing nodes would occasion constant tendencies from opposite extremities of every diameter, to the formation of confocal elliptic orbits, with major axes of $\frac{3r}{2}$ and minor axes of $\sqrt{8}r$. Those ellipses would mutually intersect at $\frac{2r}{3}$, thus tending, through collision of particles, to form a belt at that distance from the centre. The *v. v.* communicated by simple fall from r to $\frac{2r}{3} = \frac{1}{2}gr$, which is equivalent to *v. v.* of circular-orbital revolution at r, and also to the orbital *v. v.* gained by contraction from r to $\frac{r}{2}$. The internal motions and collisions of the particles of the belt would form a condensation of the densest and comparatively inelastic materials, until the whole acquired the mean orbital *v. v.*, $\frac{gr + 2\,gr}{4} = \frac{3\,gr}{4}$, which is the normal orbital *v. v.* at the nodes of aggregating collision, $\frac{2r}{3}$. The following table exhibits the double tendency, to nebular rupture and to nebular aggregation, starting from the point which would account for the orbital velocity of Neptune. The approximation of "B" to the planetary distance which would satisfy Bode's law, and the indications of Neptunian aggregation during direct fall towards the centre, lend new confirmation to the views which I have already expressed, in regard to the *rationale* of Bode's law, and the relative masses of the two outer planets.



	Rupturing Nodes.	Secondary Nodes.	Planets.		
2 × ♆ *a**	60.93910	40.62606	"B"	=	38.8
♆ *a*	30.46955	20.31303	♅ *a*	=	20.68
½ ♆ *a*	15.23478	10.15652	♄ *a*	=	10.34
¼ ♆ *a*	7.61739	5.07826	♃ *p**	=	4.89

* *a* secular aphelion; *p* secular perihelion.

The following tables exhibit the modifying influences of other simple nodes :

⅔ ♂	1.0158	⊕	1.0000	½ ♂	.7618	♀ *a*	.7744
⅔ ⊕	.6667	♀ *p*	.6722	⅔ × ⅔ ♂	.6772	♀ *p*	.6722
⅔ ♀	.4822	☿ *a*	.4768	½ ⊕ *p*	.4661	☿ *a*	.4768
⅔ ☿ *a*	.3178	☿ *p*	.2974	⅓ ⊕ *p*	.3111	☿ *p*	.2974

In the inter-asteroidal belt and ellipse, bounded by ♂ *a* and ☿ *p:*

Middle of belt,	1.0169	⊕	1.0000
Middle of ellipse,	.7194	♀	.7233

Jupiter is similarly situated in reference to the Neptune-Uranian, and the Uranus-Saturnian ellipses :

Middle of ♆ *a* ♅ *a*	4.8952	Middle of ♅ ♄	4.8224	♃ *p*	4.8863
" ♆ *p* ♅	5.2073	" ♅ ♄ *p*	5.2246	♃	5.2028
" ♆ *a* ♅	5.6430	" ♅ *a* ♄	5.5701	♃ *a*	5.5193

Saturn is similarly situated in reference to the Neptune-Saturnian and Sun-Uranian ellipses :

Mid. ☉ ♅ *p*	8.8440			♄ *p*	8.7345
" ☉ ♅	9.5918	Mid. ♄ *a* ♆ *p*	9.6275	♄	9.5389
" ☉ ♅ *a*	10.3396	" ♄ *p* ♆ *p*	10.4319	♄ *a*	10.3433

There are, doubtless, many other results of early inter-orbital action, especially in connection with collisions in confocal ellipses, which would furnish interesting subjects of investigation. For example, when the Jupiter belt was completely severed (♃ s. p.), and the Earth and Venus belts were beginning to form (s. a.), the orbital collisions were near the limits of the Mars belt.

Elliptic collision	♃ s. p.	⊕ s. a.	1.753	♂ s. a.	1.736
" "	♃ s. p.	♀ s. a.	1.337	♂ s. p.	1.311

If we take the radius of nebular rupturing fall for the surface of Sun's homogeneous luminiferous atmosphere (2 × light-modulus), and reduce it in the ratio of mean radially-varying to uniform-circular velocity $\left[\frac{2}{\pi}\right]$*, rupturing nodes (½) and falls of condensation (1 ÷ 11.656854) give the following table :

		1st Cond. Fall.	2d Cond. Fall.	Rad. Vec.	
4 M ÷ π	2807.4	240.84	20.67	♅ *a*	20.68
2 " "	1403.7	120.42	10.33	♄ *a*	10.34
1 " "	701.9	60.21	5.17	♃	5.20
½ " "	350.9	30.10	....	♆	30.03
¼ " "	175.5	15.05	1.29	♂ *p*	1.31
⅛ " "	87.7	7.53	.65	♀ *p*	.67

This seems to point, like the Neptune-Saturnian ellipse in a previous comparison, and like the present comparatively nebulous condition of Saturn itself, to Saturn as an important centre of early ring aggregation, as if our nebula were, at first, a ring vortex. The indication is confirmed by the similar densities of Saturn and Neptune ; the similar densities of Uranus, Jupiter and Sun ; the fact that "these four planets form a system by themselves, which is practically independent of the other planets of the system;"* the present approximate accordance between the transit of light through the Uranus-Telluric major-axis and the limit of planetary velocity at Sun's surface ; and the following comparison between the 2d and 3d condensation falls :

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* If synchronous undulations are interrupted by an obstacle, so as to produce accelerated motion towards a centre, the mean radius of variable motion is $\frac{2}{\pi}$ the radius of corresponding uniform motion.

Rad. Vec.		2d C. Fall.	3d C. Fall.	Rad. Vec.	
♅ *a*	20.68	20.67	1.77	♂ *a*	1.74
♄ *a*	10.34	10.33	.89	⊕ *p*	.93
♃	5.20	5.17	.44	☿ *a*	.48
Ast.	2.59	2.59	.22	V *a*	?

If the 3d fall had been counted from Saturn's secular perihelion instead of from his secular aphelion, the distance would have been .75, Venus's mean aphelion being .75.

The peculiar indication of the Uranus-Telluric ellipse, the central position of Earth in the belt of greatest density, and the absence of any explicit indication of our planet in most of the foregoing comparisons, suggest the possibility that its place may have been fixed by a special law. Its secular perihelion (.93226) is near the fifth rupturing node of Neptune's mean distance ($30.03386 \div 2^5 = .93856$).

The stellar-Solar parabola points to a time when *a* Centauri may have been at a nebular rupturing point, relatively to the Sun. The lowest and highest estimates for $\frac{2}{\pi}$ *a* Centauri, are, respectively, 28905200 and 30895100 solar radii. The seventh fall of condensation $(1 \div 11.656854)^7$, would give .9883 and 1.0564, showing a closeness of approximation to the present solar radius which can hardly be thought accidental. As there are two falls of condensation between $\frac{2}{\pi}$ Earth and Sun, there are five falls between *a* Centauri and Earth ; the extreme range of estimates for *a* Centauri $\div\ 11.656854^5$ being between .9818 and 1.0494 times Earth's mean radius vector. Both of these points are within the Earth belt ($p = .9323$, $a = 1.0677$).

Neptune's secular eccentricity seems to have been determined by the combined influence of condensation-fall, orbital collision, and rupturing nodes. For Neptune's secular perihelion $\div\ 11.656854 = 2.53912$; $\frac{2}{3}$ sec. aph. $\div\ 2^3 = 2.53913$.

The *gegenschein*, and other indications that the Zodiacal light may be partly owing to the remains of an early terrestrial ring, may naturally lead us to look for evidences of residuary activity in some of the outer planets. A radial oscillation at Uranus's secular aphelion would be accomplished in $10.3396^{\frac{3}{2}} = 33.247y$; a circular revolution at Saturn's secular aphelion, in $10.3433^{\frac{3}{2}} = 33.265y$; a circular revolution, at Jupiter's *mean* perihelion, in $4.9872^{\frac{3}{2}} = 11.108y$. The November meteoric cycle is $33.25y$; the Wolf Sun-spot cycle, $11.07y$.

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* Stockwell ; *Smith. Con.* 232, xiii.

There is a noteworthy numerical correspondence between the seven rupturing nodes within the planetary belt, and the seven condensation-falls from α Centauri to $\frac{\pi}{2}$ Sun. The fifth node and the fifth fall both come within the Earth belt.

If we suppose seven successive transformations of uniform into variable velocity, before the determination of the present solar mass and light-modulus (M), and five condensation falls ($n = 1 \div 11.656854$) after each transformation, we have the following approximations:

$\pi^7 \text{M} \div n^5$	30.941	Ψ a	30.470
$\pi^6 \text{M} \div n^5$	9.849	♄	9.548
$\pi^5 \text{M} \div n^5$	3.135	Hygeia	3.121
$\pi^4 \text{M}^* \div n^5$	.998	⊕	1.000
$\pi^3 \text{M} \div n^5$	.318	☿ p	.297
$\pi^2 \text{M} \div n^5$	.101		
$\pi \text{M} \div n^5$	.032		

The probability of undulating gravitating action is increased by the investigations of Bjerknes, who has shown (Comptes Rendus, lxxxiv, 1377) that two spheres, having concordant pulsations, attract each other inversely as the square of the distance; and that they repel each other according to the same law if their pulsations are opposed.

The use of the parabola † in representing expanding action is recognized by H. Ste.-Claire Deville, who states, in considering cases where vapor-densities vary with the temperature, that "the movement of a material point, taken in the expanding material, may be accurately enough represented by a parabolic function of the second degree already employed by M. Fizeau." (Comptes Rendus, lxxxiv, 1257). Deville hopes to employ the resulting relations usefully in expounding some principles of Thermo-Chemistry.

The hypothesis that the radial *vis viva* of mean rectilineal velocity may be taken as the representation of increments of heat under constant volume, while the radial *vis viva* of synchronous constant velocity, will represent simultaneous increments of heat under constant pressure, ‡ assumes that the gaseous condition is perfect.

If the Sun were nebulously diffused to 2 Ψ, the equal centrifugal and centripetal action and reaction would tend to produce a belt of "constant volume," with an inner limit at 1.4232Ψ from the equatorial surface, or $.5768\Psi$ ($= .2884\ r$) from the nucleal centre. The consequent thermodynamic undulations, the *vis viva* of central fall, the vertical collisions at $\frac{2}{3}\ r$, and Ennis's centripetal momentum, would all be simultaneously operative, and the present evidence of their past activity is unmistakable. For if we designate the primitive radius ($2\ \Psi_5$) by a; the thermodynamic ratio (.2884) by $\frac{1}{m}$; the *vis viva* ratio by $\frac{1}{2}$; the collision ratio by $\frac{2}{3}$; the Ennis, or momentum ratio ($1 \div 11.656854$) by $\frac{1}{n}$; secular perihelion, mean perihelion, mean, mean aphelion and secular aphelion respectively, by subscript $_{1,2,3,4,5}$, we find the following primary accordances:

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* π^4 M = distance of α Centauri.

† *Ante*, xvi, 507.

‡ *Ante*, xiv., 651.

$a = 2\ \Psi_5$	60.939		
$\frac{2}{3}\ a$	40.626		
$\frac{1}{2}\ a$	30.470	Ψ_5	30.470
$\frac{1}{m}\ a$	17.575	⛢$_1$	17.688
$\frac{1}{n}\ a$	5.228	♃$_3$	5.203

The inner limit of the Neptune-Uranian belt, the controlling centre of planetary mass, and, as we shall presently see, the nebular surfaces which were to determine subsequent planetary aggregations, were thus marked out, within less than one per cent., "in the beginning."

The order of time in which these dissociating influences would be completed, would be $\frac{1}{m}$, $\frac{1}{2}$, $\frac{2}{3}$, $\frac{1}{n}$. Second and third dissociations present the following agreements:

$\frac{2}{3}\ \frac{1}{m}\ a$	11.717		
$\frac{2}{3}\ \frac{1}{2}\ a$	20.313	⛢$_4$	20.044
$\frac{1}{2}\ \frac{1}{m}\ a$	8.788	♄$_1$	8.734
$\frac{1}{m} \cdot \frac{1}{m}\ a$	5.069	♃$_4$	4.978
$\frac{1}{n} \cdot \frac{1}{2}\ a$	2.614	Ast.	....
$\frac{1}{n} \cdot \frac{2}{3} \cdot \frac{1}{2}\ a$	1.743	♂$_5$	1.736
$\frac{1}{n} \cdot \frac{1}{m}\ a$	1.508	♂$_3$	1.524
$\frac{1}{n} \cdot \frac{2}{3}\ \frac{1}{m}\ a$	1.005	⊕$_3$	1.000
$\frac{1}{n} \cdot \frac{1}{2} \cdot \frac{1}{m}\ a$	.754	♀$_4$	.749
$\frac{1}{n} \cdot \frac{1}{n}\ a$	.448	☿$_4$	.455

Second dissociations, therefore, approximately fixed cardinal positions of

⛢, ♄, ♃, the asteroidal belt, ♂, and ☿; third dissociations, of ♂, ⊕ and ♀.

Numerous other interesting relations, of a similar nature, may be traced at successive stages of nebular condensation, of which some examples are given in the following table:

$\frac{1}{m}$	♆$_4$	8.749	♄$_1$	8.734
$\frac{1}{m}$	⛢$_3$	5.533	♃$_5$	5.519
$\frac{1}{m}$	♂$_4$	.474	☿$_5$	.477
$\frac{1}{m}$	⊕$_4$	.298	☿$_1$	.297
$\frac{1}{m^2}$	⛢$_2$	1.524	♂$_3$	1.524
$\frac{1}{m^2}$	♄$_1$	.726	♀$_3$	.728
$\frac{1}{m^2}$	♃$_5$	.459	☿$_4$	.455
$\frac{1}{m^3}$	♆$_3$	.720	♀$_3$	.723
$\frac{1}{n}$ .2	♆$_4$	5.205	♃$_3$	5.203
$\frac{1}{n}$	⛢$_3$	1.646	♂$_4$	1.644
$\frac{1}{n}$	♄$_1$	.749	♀$_4$	.749
$\frac{1}{n}$	♃$_5$	.473	☿$_5$	.477
$\frac{2}{3}$	⊕$_3$	.667	♀$_1$	.672
$(\frac{2}{3})^2$	♂$_5$	.772	♀$_5$	.774
$(\frac{2}{3})^2$	⊕$_5$	.475	☿$_5$	.477
$(\frac{2}{3})^2$	♀$_1$	.299	☿$_1$	.297
$(\frac{2}{3})^3$	♆$_5$	9.028	♄$_2$	9.078
$(\frac{2}{3})^3$ 2.	♆$_3$	9.558	♄$_3$	9.539
$(\frac{2}{3})^3$	⛢$_2$	5.428	♃$_4$	5.427
$(\frac{2}{3})^3$	♃$_5$	1.635	♂$_4$	1.644
$(\frac{2}{3})^3$	♂$_1$	.388	☿$_3$	.387
$(\frac{2}{3})^3$	⊕$_3$	.296	☿$_1$	.297
$(\frac{2}{3})^4$	♄$_1$	1.725	♂$_5$	1.736
$(\frac{2}{3})^4$	♃$_4$	1.075	⊕$_5$	1.068
$(\frac{2}{3})^4$	♃$_1$	.965	⊕$_2$	.966
$(\frac{2}{3})^5$	♄$_4$	1.317	♂$_1$	1.311
$(\frac{2}{3})^5$	♃$_5$	.727	♀$_3$	.728
$(\frac{2}{3})^6$	*a*	5.197	♃$_3$	5.203
$(\frac{2}{3})^6$	♃$_4$	.476	☿$_5$	.477
$(\frac{2}{3})^7$	⛢$_2$	1.072	⊕$_5$	1.068
$(\frac{2}{3})^8$	⛢$_3$	.749	♀$_4$	.749
$(\frac{2}{3})^8$	♄$_4$	.390	☿$_3$	.387

$(\frac{2}{3})^9$	$♆_2$	.773	$♀_4$	.774
$(\frac{2}{3})^9$	$⛢_2$	.477	$☿_5$	.477
$(\frac{2}{3})^{10}$	$⛢_2$	.318	$☿_2$	.319
$\frac{1}{2}$	$⛢_5$	10.340	$♄_5$	10.343
$\frac{1}{2}$	$⛢_4$	10.022	$♄_4$	10.000
$\frac{1}{2}$	$♄_4$	5.000	$♃_2$	4.978
$\frac{1}{2}$	$♂_2$	.702	$♀_2$	.698
$\frac{1}{4}$	$⛢_5$	5.170	$♃_3$	5.203
$\frac{1}{4}$	$♃_3$	1.301	$♂_1$	1.311
$\frac{1}{4}$	$♂_3$	.381	$☿_3$	.387
$\frac{1}{8}$	$♃_4$	.678	$♀_1$	.672
$\frac{1}{16}$	$♃_2$	.311	$☿_2$	.319
$\frac{1}{32}$	$♆_1$	.929	$⊕_1$	.932
$\frac{1}{32}$	$♄_3$	.298	$☿_1$	.297
$\frac{1}{64}$	$♆_5$	.476	$☿_5$	.477

The list might be indefinitely extended by admitting a wider range of differences, as well as by various combinations of the four primitive dissociating factors. After rotation was set up, the centre of rotating inertia, to which Alexander first called attention,* asserted its influence, as may be seen by the following comparisons :

$\frac{1}{r}$ †	$♆_4$	19.184	$⛢_3$	19.184
$\frac{1}{r}$	$♄_1$	5.524	$♃_5$	5.519
$\frac{1}{r}$	$♂_4$	1.040	$⊕_4$	1.034
$\frac{1}{r}$	$♂_3$	.964	$⊕_2$	.966
$\frac{1}{r}$	$⊕_5$	.675	$♀_1$	.672
$\frac{1}{r}$	$♀_4$	.474	$☿_5$	.477
$\frac{1}{r}$	$♀_3$	.457	$☿_4$	.455
$\frac{1}{r^2}$	$♂_5$	.695	$♀_2$	.698
$\frac{1}{r^3}$	$⛢_5$	5.231	$♃_3$	5.203
$\frac{1}{r^3}$	$⛢_3$	4.853	$♃_1$	4.886
$\frac{1}{r^3}$	$♃_5$	1.397	$♂_2$	1.403
$\frac{1}{r^3}$	$♃_3$	1.316	$♂_1$	1.311

* *Smithsonian Contributions*, 280.

† $\frac{1}{r} = \sqrt{.4}$

$\frac{1}{r^3}$	♂$_3$	.885	☿$_3$	.387
$\frac{1}{r^4}.2$	♆$_2$	9.514	♄$_3$	9.539
$\frac{1}{r^4}$	♄$_5$	1.655	♂$_4$	1.644
$\frac{1}{r^4}$	♄$_3$	1.526	♂$_3$	1.524
$\frac{1}{r^4}$	♄$_1$	1.398	♂$_2$	1.403
$\frac{1}{r^4}$	♃$_1$	.782	♀$_5$	.774
$\frac{1}{r^5}$	♄$_3$	.965	⊕$_2$	.966
$\frac{1}{r^6}$	⛢$_5$	1.323	♂$_1$	1.311
$\frac{1}{r^6}$	♃$_2$	.319	☿$_2$	.319
$\frac{1}{r^7}$	⛢$_3$	.776	♀$_5$	.774
$\frac{1}{r^7}$	♄$_3$	.386	☿$_3$	.307
$\frac{1}{r^8}$	♆$_4$	.777	♀$_5$	.774
$\frac{1}{r^8}$	⛢$_1$	.453	☿$_4$	.455
$\frac{1}{r^9}.2$	♆$_3$	.973	⊕$_2$	.966
$\frac{1}{r^9}$	⛢$_2$	.297	☿$_1$	.297

If we take geometrical, instead of arithmetical means, and place $\frac{1}{3}a$ at Neptune's mean aphelion instead of his secular aphelion, the influence of orbital collisions on positions of intra-asteroidal planets becomes still more striking. For we find, as theoretical (T) and observed (O) values :

	O.		T.	(T–O). ÷ T.
♃$_3$	5.203	$.\frac{a}{n}$	5.223	+.004
♂$_3$	1.524	$(\frac{2}{3})^3 .\frac{a}{n}$	1.548	+.016
⊕$_4$	1.033	$(\frac{2}{3})^4 .\frac{a}{n}$	1.032	—.001
♀$_2$	.697	$(\frac{2}{3})^5 .\frac{a}{n}$	.688	—.014
☿$_4$	.452	$(\frac{2}{3})^6 .\frac{a}{n}$	.459	+.015
Mean	1.209		1.213	+.004

Comparing the positions of inter-Uranian planets which are most correctly represented in the foregoing tables, and taking the geometrical means for the five positions of each planet, we find :

	O.	T.	(T-O) ÷ T.
♄	9.521	9.512	—.0009
♃	5.197	5.196	—.0002
♂	1.516	1.517	+.0014
⊕	.999	1.001	+.0021
♀	.722	.721	—.0012
☿	.380	.380	+.0001
Mean	3.567	3.567	+.0002

A similar closeness of accordance is shown by comparing the positions of the intra-Nepturian planets which appear to be most typical :

	O.			T.	(T-O) ÷ T.
♅$_3$	19.184	$\frac{1}{r}$	Ψ$_4$	19.186	+.0001
♄$_5$	10.348	$\frac{1}{2}$	♅$_5$	10.340	—.0004
♃$_4$	5.427	$(\frac{2}{3})^3$	♅$_2$	5.429	+.0003
♂$_3$	1.524	$\frac{1}{m^2}$	♅$_2$	1.524	+.0002
⊕$_2$	.966	$\frac{1}{r^5}$	♄$_3$	.965	—.0009
♀$_4$	.749	$(\frac{2}{3})^8$	♅$_3$	.749	—.0005
☿$_5$	.477	$(\frac{2}{3})^9$	♅$_2$	.477	—.0003
Mean	2.473			2.473	—.0002

The variation of the nucleal radius as the ¾ power of the atmospheric radius,* may furnish an explanation of results which seem to have been obtained nearly simultaneously, by Silas W. Holman (A. A. A. S. June 14, 1876 ; P. Mag, Feb., 1877 ; p. 81), and E. Warburg (Pogg. Ann. clix, 415 ; communicated 9th July, 1876). Holman concludes, from the results of a number of careful experiments, that the "viscosity of air increases proportionally to the 0.77 power nearly, of the absolute temperature, between 0° and 100° C." The extreme range of his results is .738 to .799. Warburg, from experiments both with hydrogen and with air, deduces the exponents between 20° and 100°, .76 for air (the extremes being .74 and .76), and "about ⅔" for hydrogen (the extremes being .57 and .65). The closeness, the narrow range, and the mutual confirmation of these independent results, as well as the new analogy between molar and molecular forces, which seems to be indicated by the atmospheric exponents, are all interesting. The viscous particles, so far as they are affected by the same movements, may be compared to the rotating particles of a solid nucleus ; the thermal undulations, in a supposed æthereal medium, present a like analogy to the motions of an elastic atmosphere. The well known anomalies in the elasticity of hydrogen are in accordance with its viscosity. Warburg's extremes (hydrogen .57, air .76) seem to point towards secondary nucleal and atmospheric relations between air and hydrogen.

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* *Ante*, xiv, 305 *et. al.*

In my identification of the velocity of solar dissociation with the velocity of light,[*] although the conception of successive wave impulses seems most natural, it is by no means essential. If the pressure of the ultimate force is constant, the result is the same. The ratio of the velocity of dissociation to the velocity of perfect fluidity,[†] is approximately illustrated by Draper's estimate of the ratio between the temperature of glow (977° F., or 1436° from absolute 0°) and the temperature of fluidity (32° F., or 491° from absolute 0°; $1436 \div 491 = 2.9$). Here complete fluidity is compared with incipient glow. The ratio $\pi : 1$ would require an additional allowance of 107°, or about 7.5 per cent., for the difference between the temperature of complete and incipient glow. If the comparison were made at 0° F., we should have $1436 \div 459 = 3.13$.

The *vis viva* of terrestrial dissociation being equivalent to ½ the *v. v.* of incipient planetary dissociation at the Sun,[‡] the temperature ratio of water vaporization to dissociation furnishes another illustration of a similar character. Deville (C. Rendus, lxxxiv, 1259) quotes the estimates made by himself and Debray (2500°), and by Bunsen (2800°), of the temperature at which nearly half of the vapor of water is reduced to its elements, hydrogen and oxygen. The ratio 2800° : 100° is a very probable estimate of the ratio between solar and terrestrial superficial gravitation.

NOTE.—August 23, 1877. In consequence of a remark near the opening of the foregoing paper, Dr. Draper recently proposed that I should test some of my views by an examination of the solar spectrum. I accordingly undertook a preliminary investigation, which has already yielded the following results:

In the harmonic progression, $\frac{c}{n}, \frac{c}{n+a}, \frac{c}{n+2a}$, etc., let c = wave-length of Fraunhofer line A = 761.20 millionths of a millimetre; $n = 1.0153$; $a = .0918$; and we find the following accordances:

Numerator.	Denominators.	Quotients.	Observed values.
761.20	$n + a$	687.75	687.49 = B
	$n + 3a$	589.89	589.74 = D^1
	$n + 6a$	486.14	486.52 = F
	$n + 10a$	393.79	393.59 = H^1

The "observed values" are the wave-lengths, as determined by Dr. Wolcott Gibbs (Amer. Jour. Sci. [2] xliii, 4). The lines between A and B have not been studied sufficiently to fix their wave-lengths; it seems likely that $A \div n$ may be a *bright* line, and thus belong to the field of investigation which Professor Draper has so brilliantly opened. The greatest difference between the above theoretical and observed values, is less than four ten-millionths of a millimetre, and, therefore, very far within the limit of probable errors of observation.

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[*] *Ante*, xvi, 307, *et al.*

[†] Ib. p. 305.

[‡] Ib. p. 307-8.

My papers on planetary harmonies have shown that alternate planetary positions manifest the greatest simplicity of law, intermediate positions being modified by requirements of mutual equilibrium, which help to give stability to the system. The same thing seems to be true of the Fraunhofer lines. The "figurate" symmetry of the above divisor differences (1 *a*, 3 *a*, 6 *a*, 10 *a*) is especially noticeable, and suggestive of my equation between the principal planetary masses:

(Neptune) $^{1}\times$ (Uranus) $^{3}\times$ (Jupiter) $^{6}\times$ (Saturn) $^{-10}=1$.

After finding this relation among the most important lines, I sought for traces of the "morning-star" music among the subordinate lines, with the following result: I have introduced Kirchhoff's scale-measurements, in order that the lines may be identified without the necessity of reference to Dr. Gibbs's papers.

Divisors.	Quotients.	Observed values.	Scale measurem'ts.
$n+2a$	635.07	634.05	783.8
$n+4a$	550.72	550.70	1306.7
$n+5a$	516.42	517.15	1655.6
$n+7a$	459.22	458.66	2436.5
$n+8a$	435.12	435.67	2775.7
$n+9a$	413.43	(413.76)	(?)

There is no single line corresponding to the harmonic denominator $n+9a$. The bracketed number is the arithmetical mean between Kirchhoff line 2869.7 = 430.37, and H = 397.16. This again, may either indicate a *bright* line, or it may await future discovery for a true interpretation.

The equality, which I had previously pointed out, between the average limiting velocities of solar centrifugal and tangential dissociation, and the velocity of light, induced me to apply the same harmonic series to the solar system. In some of the papers on cosmical and molecular force, which I have had the honor of communicating to the society (Proc. Soc. Phil. Amer. vol. xiii.), I had taken steps in this direction, but they were comparatively feeble, for want of sufficient definite guidance. They had, however, shown very clearly, that, in ultimate physical generalizations, the study of elastic reaction is quite as needful as the study of centripetal action, and *vice versa*. One of the most important facts, in connection with such comparative study, is the variation of elastic density in geometrical ratio, when distance varies in arithmetical ratio. In making an operative application of the spectral harmonic series, the several terms should therefore be taken exponentially, and the greatest activity should be looked for at inter-nodes, and presumably nearly midway between successive nodes. The Sun's radius was naturally suggested as a fundamental unit.

The process of calculation is nearly as simple as Columbus's egg, but, on account of its novel application, it may be well to give it in full. The common astronomical unit is Earth's mean radius vector; its value, in units of solar radius, is 214.86. The harmonic exponential numerator, is Neptune's mean radius vector, which is 30.03386 astronomical units, or 30.03386 × 214.86 = 6453.06 solar radii. The logarithm of 6453.06 is 3.809766; log. log. 6453.06 = log. 3.809766 = .580897. By the same method we find log. log. Uranus = .558210; .580897 — .558210 = .022687 = log. 1.0536. Uranus's mean radius vector represents, therefore, the 1.0536th root of Neptune's mean radius vector, and 1.0536 is the denominator of the first planetary fractional exponent. The first mid-nodal denominator, in the foregoing spectral-line series, between A ÷ 1 and A ÷ $(n + a)$ is $(1 + 1.1068) \div 2 = 1.0534$; the second mid-nodal denominator is $(n + a + n + 2a) \div 2 = 1.1527$; and so on, until we reach the sixth denominator, when, perhaps on account of great nebular condensation, the harmonic denominator-differences become $\frac{5}{4}$ of .0918, instead of .0918, bringing a second exact correspondence between the spectral and planetary denominators in the orbit of Venus. The following table contains all the figures that are required for the whole calculation:

Expon'l Den'rs.	Log. Den'rs.	Log. log. r. vec.	Log. r. I.	Log. r. II.	Theoretical.	Observed.
1.0534	.022593	.558304	3.61689	1.28473	19.263	19.184
1.1527	.061716	.519181	3.30576	.97360	9.410	9.539
1.2445	.094994	.485903	3.06128	.72912	5.359	5.427
1.3368	.126066	.454831	2.84991	.51775	3.294	?
1.4281	.154758	.426139	2.66771	.33555	2.165	?
1.5199	.181815	.399082	2.50658	.17442	1.494	1.524
1.6346	.213412	.367485	2.33070	$\bar{1}.99854$	.997	1.000
1.7494	.242889	.338008	2.17775	$\bar{1}.84559$	.701	.698
1.8641	.270469	.310428	2.04375	$\bar{1}.71159$	.515	.510
1.9789	.296424	.284473	1.92519	$\bar{1}.59303$	.392	.387

The log. logs., in the third column, are obtained by subtracting the logs. of the exponential denominators (column 2) from the log. log. of the exponential numerator (.580897). Column 4 contains the antilogs. of column 3; column 5 is column 4 reduced to logs. of Earth's mean radius-vector, by substracting log. 214.86 = 2.332155; column 6 contains the antilogs. of column 5. Column 7 gives the mean distances of Uranus, Saturn, Mars, Earth, and Mercury; the mean aphelion of Jupiter; the mean perihelion of Venus; and the arithmetical mean between Mercury's secular perihelion, and Venus's mean distance.

We are now prepared to find the significance of the remaining Fraunhofer lines, which is shown in the following table:

Line.	Wave Length.	Denominator.	Planetary Den'rs.	Theoretical Den'rs.
C	656.67	1.1590	1.1576 = Sat. p.*	
E	527.38	1.4434	Asteroidal.	
b	517.70	1.4704		$1.4740 = n + 5a$
G	431.03	1.7660	1.7640 = Ven. s.p.	
H	397.16	1.9166	1.9139 = Mer. a.	

* p., *mean perihelion;* s. p., *secular perihelion;* a., *mean aphelion.*

The following table gives a comparative view of the spectral and planetary series:

Spectral	Differences.	Planetary	Diff.
α 1.0000		1.0000	
	$\frac{1}{6}a$		$\frac{7}{12}a$
β 1.0150			
	a	$\frac{1}{2}(\alpha+\gamma)$ 1.0534	
			$\frac{13}{12}a$
γ 1.1068			
	a	$\frac{1}{2}(\gamma+\delta)$ 1.1527	
			a
δ 1.1986			
	a	$\frac{1}{2}(\delta+\varepsilon)$ 1.2445	
			a
ε 1.2904			
	a	$\frac{1}{2}(\varepsilon+\zeta)$ 1.3363	
			a
ζ 1.3822			
	a	$\frac{1}{2}(\zeta+\eta)$ 1.4281	
			a
η 1.4740			
	a	$\frac{1}{2}(\eta+\theta)$ 1.5199	
			$\frac{5}{4}a$
θ 1.5658			
	a	$\frac{1}{2}(\theta+\iota)+\frac{1}{4}a$ 1.6347	
ι 1.6576			
	a		$\frac{5}{4}a$
κ 1.7494		κ 1.7494	
	a		$\frac{5}{4}a$
λ 1.8412			
	a		
μ 1.9330		$\frac{1}{2}(\lambda+\mu)-\frac{1}{4}a$ 1.8641	
	a		$\frac{5}{4}a$
ν 2.0248		$\frac{1}{2}(\mu+\nu)$ 1.9789	
	a		$\frac{5}{4}a$
o 2.1166		$\frac{1}{2}(\nu+o)+\frac{1}{4}\sigma$ 2.0936	
	a		$\frac{5}{4}a$
π 2.2084		π 2.2084	

In the fundamental harmonic denominators, it will be seen that $a = 6n$, and 6 is the figurate exponent of Jupiter in the equation of planetary masses. The value of n is the quotient of (Jupiter × perihelion radius-vector) by (Sun × solar radius). The significance of this quotient is obvious, on account of the preponderating influence of the two controlling members of our system. It becomes still more interesting upon examining the portion of the spectrum which represents Jupiter's most powerful reaction against solar action.

As the harmonic basis is Jupiter's *present* perihelion, it seems likely that there may be some changes in the relative positions of the spectral lines, with Jupiter's changing eccentricity. As this change is less than $\frac{1}{175}$ of one per cent. per annum, its influence cannot be detected by direct observation. But it may be worth while to institute careful comparisons between solar spectra taken at our perihelion, aphelion, perijove and apojove, in order to find whether the lines are modified in any way by Earth's position relatively to Sun and Jupiter.

CONTRIBUTIONS FROM THE LABORATORY OF THE UNIVERSITY OF PENNSYLVANIA.

No. XI.

On some Tellurium and Vanadium Minerals.

BY F. A. GENTH.

(*Read before the American Philosophical Society, August 17th,* 1877.)

Since the publication of my papers : "On American Tellurium and Bismuth Minerals," read before the American Philosophical Society, August 21, 1874, and "On Some American Vanadium Minerals," published in the American Journal of Science and Arts, July, 1876, I have made several observations which I believe to be worthy of being placed upon record.

1. NATIVE TELLURIUM.

Its occurrence at the Red Cloud Mine, where it is a comparatively rare mineral, has previously been mentioned. Recent developments in Colorado have furnished a number of new localities, in some of which it is found in considerable quantities and in peculiar varieties, associated with other very interesting minerals.

1. In Magnolia District, Boulder County, at the Keystone Mine and Mountain Lion Mine (which are working the same vein), also at the Dun Raven Mine, it occurs in crystals and crystalline masses. The crystals are usually small and very indistinct, much distorted, cavernous, and the prismatic planes longitudinally, deeply striated; often surrounding quartz crystals; occasionally, besides the planes of the hexagonal prism, rhombohedral and basal planes can be observed; it is also found in columnar masses and, disseminated in grains, through other minerals.

Sometimes it forms sheets and thin plates between the ores, which consist of quartz, mixed with a peculiar greenish vanadiferous mineral (? roscoelite), coloradoite, calaverite, pyrite, &c. This variety has often the appearance of "slickensides," and is sometimes in masses as thin as paper, occasionally, however ⅛ of an inch in thickness; it is dark grey, on a fresh fracture greyish white; it is finely granular and of very little lustre. The specific gravity of the pure mineral (making allowance for the admixed quartz) was found to be 6.275.

The analysis gave, after deducting 8.90% of quartz, as follows :

Au	=	0.60
Ag	=	0.07
Te	=	96.91
V_2O_3	=	0.49
FeO	=	0.78
Hg, Al_2O_3, MgO K_2O, &c.	=	1.15
		100.00

2. A very peculiar variety of native tellurium occurs at the Mountain Lion Mine, where it is associated with quartz and imbedded in a greenish, clayey mineral. It has been discovered by Mr. Theodore Berdell, of Boulder, Colorado, who very kindly furnished me with this and most of the other specimens from this mine.

He distinguished it as "lionite." It occurs in flat, plate-like masses of $\frac{1}{8}$ to $\frac{3}{16}$ of an inch in thickness; it has a dark grey color, very little lustre, and a somewhat columnar structure at right angles with the plates; brittle. $H = 3$; Sp. Gr. $= 4.005$.

Examined with a strong magnifying glass it shows numerous air-holes, but otherwise seems to be quite uniform. It looks very much as if it had been melted and not unlike a "matte." The analyses showed an admixture of a very large quantity of silicic acid and silicates, and it is impossible to conceive, how such heterogeneous substances could have formed such a uniform material. It can, of course, not be considered as a species, but only as a variety of native tellurium. The analyses gave:

		I.	II.
Au	=	1.38	1.53
Ag	=	0.25	0.25
Te	=	55.86	55.54
SiO_2	=	34.72	35.91
Al_2O_3 Fe_2O_3	=	6.15	6.14
MgO	=	0.17	0.19
CaO	=	0.48	0.26
		99.01	99.82

3. Very minute, but brilliant, crystals of native tellurium, in combinations of an hexagonal prism and pyramid have been found in cavities of quartz at the Smuggler Mine, Ballerat District, Boulder County, Colorado. They are mostly distorted and have the appearance of rhombic prisms, from the enlargement of two opposite hexagonal planes at the expense of the four others. The hexagonal planes are deeply striated, and the pyramidal ones rarely well developed. The ore from the deeper part of the vein consists largely of native tellurium in a granular variety, associated with sylvanite, coloradoite, &c. The analyses of it, after deducting in the first 28.04% of quartz, and in the second 65.21% of quartz, gave:

		I.	II.
Au	=	3.40	2.18
Ag	=	1.69	1.15
Hg	=	1.07	1.34
Cu	=	0.51	0.43
Pb	=	0.74	1.02
Fe	=	0.12	0.18
MgO	=	0.12	0.06
Te	=	92.29	[93.64] by diff.
		99.94	100.00

4. The largest quantities of native tellurium have been observed at the John Jay Mine, in Central District, Boulder County, Colorado. I was informed that masses of 25 pounds in weight had been found there. I am indebted to the owner, Mr. A. J. Van Deren, for very fine specimens, which were taken from his mine at a depth of 30 to 35 feet.

The tellurium is more or less mixed with quartz, it is granular to columnar in structure and of a color between tin-white and lead-grey. In the cavities and on the surface are rarely found tellurous oxide or tellurite, in minute crystals.

A very pure specimen, after the deduction of 14.08% of quartz, contained :

Au	=	1.04
Ag	=	0.20
Zn	=	0.32
Fe	=	0.89
Te	=	97.94
		100.39

2. HESSITE.

My friend, Mr. August Raht, wrote me from Utah on the 20th February, 1877, that, in testing an ore from the Kearsage Mine, Dry Cañyon, Utah, he found it to contain large quantities of tellurium, and afterwards, in analyzing a pure piece before the blow-pipe, obtained :

Ag	=	58.790
Au	=	0.103

It is evidently hessite, almost free from gold, similar to that which I described from the Red Cloud Mine, Colorado, where it has been *once* found as a very great rarity.

3. COLORADOITE, A NEW MINERAL.

I have mentioned the occurrence of telluride of mercury, which I have called "coloradoite" already at the meeting of the American Philosophical Society of October 20th, 1876. I observed it amongst ores from the Keystone Mine, Magnolia District, received for examination by the late Dr. W. H. Wenrich, of Denver. It also occurs at the Mountain Lion Mine; a specimen of ore, for which I am indebted to Commodore Stephen Decatur, Centennial Commissioner of Colorado, and which was found at the depth of 8 or 10 feet at the Smuggler Mine, Ballerat District, proved also to be this interesting species.

Not crystallized, without cleavage; massive, somewhat granular; that from the Smuggler inclining to an imperfectly columnar structure. Fracture uneven to subconchoidal. Hardness about 3 ; Sp. Gr. = 8.627—(pure mineral, after making allowance for the admixture of native tellurium and quartz). Lustre metallic ; color iron-black, inclining to grey, with a very faint purplish hue; frequently tarnished with purplish, blue and green colors.

B. B. in a tube slightly decrepitates, fuses and yields an abundant sublimate of metallic mercury, also drops of tellurous oxide and, next to the assay, metallic tellurium. On charcoal it gives a greenish flame and white sublimate. Soluble in nitric acid. Very rare. At the Keystone and Mountain Lion Mines, associated with native tellurium and quartz; at the Smuggler Mine it is often mixed with native gold, resulting from sylvanite, more or less completely decomposed, native tellurium and tellurite. It is probable that the admixture of sylvanite produces its columnar structure.

I have endeavored by mechanical means to separate, as much as possible, the pure coloradoite from the associated minerals, but was not successful.

The best selected fragments from the Smuggler were first digested for some time with ammonic hydrate to remove the tellurite; the remaining impurities are gold, sylvanite and quartz.

The analyses of the heaviest portions from the Keystone Mine, which have been obtained by levigation, show a higher percentage of mercury, the lighter a larger admixture of tellurium. The results leave no doubt that the pure coloradoite has the composition: Hg Te, corresponding with that of Cinnabar and Tiemannite, and containing:

Hg = 60.98
Te = 39.02

The specimens from the Keystone Mine, after deducting quartz and gold, gave the following results:

	I.	II.	III.	IV.	V.
Quartz and Gold	= [28.50]	— [46.83]	— [25.18]	— [8.46]	— [20.72]
Hg	= 56.33	— 52.28	— 51.48	— 49.80	— 45.63
Te	= 43.81	— 42.95	— 44.25	— 46.74	— 50.05
Al_2O_3, Fe_2O_3	= traces	= 2.44	not determined.		
V_2O_3		= 0.70			
MgO		= 0.11			
CaO		= 0.84			
K_2O, Na_2O					
	100.14	99.32			

SMUGGLER MINE.

		VI.		VII.
Quartz	=	[2.90]	—	[3.05
Au	=	3.46	—	7.67
Ag	=	2.42	—	7.18
Hg	=	55.80	—	48.74
Cu	=	trace	—	0.16

SMUGGLER MINE—*Continued.*

		VI.		VII.
Zn	=	trace	—	0.50
Fe	=	1.35	—	0.92
Te	=	36.24	—	34.49
		99.27		99.66

I. Contains 92.38 % coloradoite and 7.76 % native tellurium.
II. " 85.74 " " " 9.49 " " "
III. " 84.43 " " " 11.30 " " "
IV. " 81.67 " " " 14.87 " " "
V. " 74.83 " " " 20.85 " " "
VI. " 91.51 " "
VII. " 79.93 " "

When I first received the mineral from the Smuggler, the preliminary examination of it made me think that gold and silver might be essential constituents of the same; the subsequent analyses showed them to be admixtures. The specimen which furnished the material for investigation, having come from near the surface, contained such a quantity of tellurite, that I was anxious to analyze the ore from the undecomposed part of the vein, and, for this reason, delayed the publication of my results for over six months. After a great deal of trouble, I secured a specimen, but unfortunately, it proved to be almost pure native tellurium (of which I gave the analyses above), I. containing an admixture of only 1.75 %, and II. of 2.20 % of coloradoite.

4. CALAVERITE.

I established this species nine years ago, on very minute quantities found associated with petzite, at the Stanislaus Mine, Calaveras County, California; then I observed it again as a great rarity at the Red Cloud, and published an analysis made with only 0.1654 grammes. From Mr. Berdell I received a short time ago a specimen, which furnished me with more than five grammes of calaverite, mixed only with a small quantity of quartz and coated with ? roscoelite. A reëxamination of this rare species was therefore highly desirable.

In very minute, imperfect crystals, resembling rhombic or monoclinic forms, but too indistinct for a more exact determination; cleavage indistinct; massive granular; fracture uneven.

H = 2.5; Sp. Gr. (of the pure mineral, less quartz), = 9.043. Pale bronze yellow; brittle. In thin seams and disseminated in quartz and gangue-rock at the Keystone and Mountain Lion Mines.

The analyses gave, after deducting in I. 4.96% of quartz, and in II. 4.00% of quartz :

		I.		II.		Calculated.
Au	=	38.75	—	38.91	—	39.01
Ag	=	3.03	—	3.08	—	3.06
Te	=	57.32		——	—	57.93
V_2O_3	=	0.05		——		
FeO	=	0.30		——		
Al_2O_3, MgO, &c., not det'd.	=	0.55		——		
		100.00				100.00

These analyses give the ratios of (Au Ag): Te = 1 : 2; Au : Ag = 7 : 1.

The composition of calaverite, corresponding with the above analyses, is therefore :

$$(\tfrac{7}{8}\ \mathrm{Au}\ \tfrac{1}{8}\ \mathrm{Ag})\ \mathrm{Te}_2.$$

In "Nature," of March 8th, 1877, it is stated that at the February meeting of the Hungarian Geological Society, Professor Krenner announced the discovery at Nagy-Ag, in Transylvania, of a pure *Telluride of gold,* in a crystalline state, which he calls "bunsenite" (a name already given by Prof. J. D. Dana, in 1868, to the niccolous oxide from Johanngeorgenstadt, described by Bergemann). As I have no access to the original publication, I am unable to decide whether it is different from calaverite ; perhaps it is a variety even more free from silver than those of this country.

5. TELLURITE.

Already in 1842, Petz observed tellurous oxide, associated with native tellurium at Facebay and Zalathna in Transylvania. It has never been observed from any other locality, until I have lately noticed it with tellurium at the Keystone and Smuggler Mines, but especially in cavities and fissures of the native tellurium of the John Jay Mine, where it is found in minute white, yellowish-white and yellow crystals, mostly prismatic, often longitudinally striated, isolated or aggregated into bundles ; a few of the white crystals are acute rhombic pyramids. Cleavage eminent in one direction.

Lustre vitreous inclining to resinous, on the cleavage plane adamantine.

Readily soluble in ammonic hydrate ; the solution contains only tellurite of ammonium ; the composition of tellurite is therefore, as Petz had already suggested, tellurous oxide = TeO_2.

6. MAGNOLITE, A NEW MINERAL.

This highly interesting mineral is the product of the oxydation of coloradoite. It occurs very rarely with native mercury in the upper, decomposed part of the Keystone Mine, associated with quartz, limonite and psilomelane.

In exceedingly fine needles, which under the microscope appear in bundles or tufts, sometimes radiating; some of the groups seem to have crystallized around a globule of mercury, which latter, in breaking the specimen, has fallen out, leaving a round empty space in the centre of the crystals. Color white; lustre silky.

Readily soluble in *very dilute* nitric acid, the solution yielding a precipitate of Hg Cl by hydrochloric acid; the mineral is also soluble in hydrochloric acid, the solution contains $Hg\,Cl_2$ and $Te\,Cl_4$, which proves that its composition is "mercurous tellurate" $= Hg_2\,Te\,O_4$. —

$$Hg_2Te\,O_4 + 8H\,Cl = 2\,Hg\,Cl_2 + Te\,Cl_4 + 4H_2O$$

The mineral is also blackened by ammonic hydrate.

Name after "Magnolia" District.

7. FERROTELLURITE, A NEW MINERAL.

A crystalline coating upon quartz, associated with native tellurium. Under the microscope it appears in very delicate tufts, sometimes radiating or, when in cavities, as very minute prismatic crystals of a color between straw and lemon-yellow inclining to greenish-yellow.

Insoluble in ammonic hydrate; some of the mineral, which had been treated with ammonic hydrate for the purpose of removing the tellurous oxide present, was dissolved in hydrochloric acid. The solution contained tellurous oxide, ferric oxide, and a trace of niccolous oxide; the mineral is therefore probably a ferrous tellurate $= FeTeO_4$, hence the name. The quantity at hand is too small for a fuller investigation.

It occurs at the Keystone Mine, Magnolia District, Colorado, associated with native tellurium, tellurite, and a peculiar iron sulphide, in which a part of the sulphur is replaced by tellurium. A preliminary examination of it gave $Fe = 41.01$, $Ni = 0.72$, $Te = 4.06$ and $S = 41.73 = 87.52$. The material for analysis was slightly oxidized, but the difference of 12.48 % is too great to be covered by this. I shall repeat the analysis, if ever I should succeed to get this mineral again.

8. ROSCOELITE.

It will be remembered, that almost simultaneously, Prof. H. E. Roscoe and I investigated the mineral, which now bears his name, his paper having been received by Royal Society on May 10th, 1876, (Proc. Royal Soc. XXV, 109.) whilst mine was written and sent to the editors of the American Journal of Science on May 16th, 1876.

I regret to say that in some of the essential points our results do not agree.

From the nature of the material and the information received from Dr. James Blake of San Francisco, no doubt can exist that, that, which he had sent to me, was as good and pure as it could be obtained. In my examination (Am. Journ. of Sc. [3] XII, 33) I showed that even the apparently purest scales, selected with the greatest pains, were not altogether free from admixtures. With the greatest difficulty I obtained enough of almost pure scales (containing only 0.85 % of quartz, gold, &c.) to make *one* analysis, which, as it was made with the greatest care, must be a very close approximation of the truth. The material of the other analyses was far more contaminated, and the results were given merely for comparison and to show the influence of the admixtures upon the analyses.

From Prof. Roscoe's analyses it does not appear that he attempted to separate the impurities by chemical means, and thus he gives the composition of the whole mixture.

He assumes the vanadium to be present as pentoxide, the iron as ferric oxide, the manganese as manganic oxide, the two latter as replacing alumina; and magnesia, lime and soda as replacing potassium oxide.

As I have made a direct determination of the state of oxydation of the vanadium, I can say *positively* that, if any, only the smaller portion of the vanadium is pentoxide. I found the composition of the vanadium oxide to be $V_6O_{11} = 2\ V_2O_3,\ V_2O_5$; but as it was obtained after allowing for the oxydation of ferrous into ferric oxide, and as the quantities of ferrous oxide have been found to vary from 1.67 to 3.30 %, it is not impossible that an insufficient quantity of oxygen has been deducted, and that the whole of the vanadium is present as V_2O_3.

Pure roscoelite contains no manganese; in Prof. Roscoe's analyses 0.85 — 1.45 % of manganic oxide have been found, which confirms my opinion that his material was not pure; but what is most astonishing to me is the very low per centage of silica which he finds.

From his analyses he calculates a formula, and from this the per centage composition, which, however, is far from corresponding with his analyses, as for instance:

Silica found = 41.25, calculated = 41.18
Potassium oxide found = 8.56, " = 14.24

I had not calculated any formula from my analyses, being in hope that I may yet be able to procure this interesting mineral in a still purer state for further investigation. For comparison I will insert my analysis (*a*) which certainly closely represents the true composition of Roscoelite, and will add the formula corresponding with the same, with this alteration however, that I consider all the vanadium as V_2O_3. It contains, after deducting 0.85 % of quartz, gold, &c.:

		Found.		Calculated.
SiO_2	=	47.69	—	49.33
Al_2O_3	=	14.10	—	14.09
V_2O_3	=	20.56	—	20.62
FeO	=	1.67	—	1.64
MgO	=	2.00	—	1.83
Li_2O	=	trace.	—	——
Na_2O	=	0.19	—	——
K_2O	=	7.59	—	7.55
Ignition	=	4.96	—	4.94
		98.76		100.00

The analysis agrees with the formula :

$$\overset{\text{I}}{R}_2\ \overset{\text{II}}{R}\ \overset{\text{VI}}{R}_2\ Si_{12}\ O_{32}\ +\ 4\,H_2O$$

$$\overset{\text{I}}{R} = K$$

$$\overset{\text{II}}{R} = Mg : Fe = 2 : 1$$

$$\overset{\text{VI}}{\bar{R}} = \bar{Al} : \bar{V} = 1 : 1$$

or, $K_2\ (MgFe)\ (\bar{Al}\ \bar{V})_2\ Si_{12}\ O_{32}\ +\ 4\ H_2O$

as will be seen from the calculated per centage.

GREEN MINERAL FROM COLORADO, ? ROSCOELITE.

A mineral which is closely allied to, and which may be only a variety of roscoelite, occurs in Magnolia District, Boulder County, Colorado, especially at the Keystone and Mountain Lion Mines. It has not yet been found in a pure state, but only as the coloring matter of quartz which, at some parts of these mines, forms the gangue rock of the veins. The purest, which I have seen, was in the form of a thin, earthy coating of a greyish-green to olive-green color upon calaverite.

Mr. Theodore Berdell, to whom I am indebted for specimens has repeatedly called my attention to this green quartz, and mentioned that it is always very rich in precious metals.

For the examination of the green mineral, which colors the quartz, about 150 grammes of the latter were powdered and separated from the metallic particles by levigation, as near as possible.

The metallic particles were found to be a mixture of native tellurium and calaverite, containing :

Native tellurium	=	55.4 %
Calaverite	=	38.5 "

The green quartz, which was left, was found on an average of four experiments to contain :

Quartz	=.	79.38 %
Tellurium	=	1.05 "
Gold	=	0.03 "
		80.46 %

This leaves for the "*green mineral*" about 19.5 % which was adopted as the basis for calculation of the results of the analyses.

In two experiments, made for the purpose of ascertaining the state of oxydation of the vanadium, it was found that after making due allowance for the oxydation of ferrous into ferric oxide by potassium permanganate, the oxygen in the vanadium pentoxide to that of the vanadium oxide in the mineral was : 5 : 3 and 5 : 2.88, which leaves no doubt that the vanadium was present as V_2O_3.

The water, which was present in small quantity, could not be determined with accuracy, because, on ignition, a portion of the tellurium went off as hydrogen telluride. In one experiment with the mixture of quartz and green mineral 1.24% was found, in a second 0.75—*both are too high.*

The following are the results of the analyses of the green mineral, after deducting quartz, &c.:

		I.	II.	III.	IV.	V.	Av'ge.
SiO_2	=	57.15	55.77	——	57.31	——	56.74
Al_2O_3	=	19.94	——	——	19.46	19.46	19.62
V_2O_3	=	8.44	——	7.37	7.79	7.51	7.78
MnO	=	trace	——	——	——	——	trace
FeO	=	3.51	——	4.52	——	3.51	3.84
MgO	=	2.87	——	2.49	2.52	——	2.63
Li_2O	=	trace	——	——	——	——	trace
Na_2O	=	0.94	——	——	——	——	0.94
K_2O	=	8.11	——	——	——	——	8.11
H_2O	=	not det.	——	——	——	——	not det
		100.96					99.66

The formula which corresponds nearest to the average analysis is :

$$\overset{\text{I}}{R}_4\ \overset{\text{II}}{R}_3\ \overset{\text{VI}}{R}_3\ Si_{24}\ O_{62} + xH_2O$$

$$\overset{\text{I}}{R} = Na : K \quad = 1 : 5$$

$$\overset{\text{II}}{R} = Mg : Fe \quad = 5 : 4$$

$$\overset{\text{VI}}{\cancel{R}} = \cancel{Al} : \cancel{V} \quad = 4 : 1$$

or, $(NaK)_4\ (Mg\ Fe)_3\ (\cancel{Al}\ \cancel{V})_3\ Si_{24}\ O_{62} + xH_2O$

Doubling, for the sake of comparison, the formula of roscoelite we have:

$$K_4\ (Mg\ Fe)_2\ (\cancel{Al}\ \cancel{V})_4\ Si_{24}\ O_{64} + 8\ H_2O\ ;$$

this seems to prove that the green mineral accompanying the tellurium ores of the Keystone and Mountain Lion Mines is, although it may be a new species, is more probably a *variety of roscoelite*, in which *a great portion of the vanadium is replaced by aluminium.*

9. VOLBORTHITE.

The Siberian volborthite has never been analyzed.

Having observed in an experiment which I made with a few fragments from Woskressenskoi, in the Government Perm, in Ural, received from my friend, Prof. Geo. J. Brush, the presence of barium, I communicated this result to him, when he immediately, with his usual great liberality and kindness, placed at my disposal for a fuller investigation, all he had. I give the results, imperfect as they may be, because they may induce others, who have better material for investigation, to repeat the analyses.

The mineral occurred as a crystalline coating on the grains and pebbles of quartz, and in the cavities of an argillaceous conglomerate ; it appeared to be very pure, of a siskingreen to a greenish yellow color, and of a pearly lustre.

As it was an impossibility to pick out the volborthite, the whole mass was crushed, merely to separate the grains of the conglomerate. These being very little acted upon, the mixture was treated with *very dilute* nitric acid, which dissolved the vanadate, and left the bulk of the conglomerate almost untouched; the latter was thrown on a tared filter, washed, dried and weighed. The amount of water in it was afterwards determined by ignition. In a separate portion of the mixture the total amount of water was also determined.

Different quantities gave 81.49 and 88.43% of insoluble residue, with 2.18 and 2.15 water. The total water was found in one sample to be 6.30%, and the ignited insoluble residue 83.74%, which would give for the *not* ignited residue 85.55%, and 14.45 soluble substances with 4.49 water or, 31.09%, which is a close approximation to the real quantity in the soluble portion.

The results of the analyses of the soluble portion, to which I add the calculated percentage of volborthite corresponding to the formula given below, are as follows:

		I.		II.		Calculated.
Si_2O_2	=	1.38	—	1.36	—	——
Al_2O_3	=	4.45	—	4.78	—	——
Fe_2O_3	=	1.77	—	0.45	—	——
MgO	=	3.01	—	1.42	—	——
CuO	=	34.04	—	38.01	—	38.41
CaO	=	4.29	—	4.49	—	6.77
BaO	=	4.29	—	4.30	—	6.17
V_2O_5	=	13.62	—	13.59	—	19.63
H_2O (by diff.)	=	[33.15]	—	[31.60]	—	29.02
		100.00		100.00		100.00

Considering silica, alumina, ferric oxide, magnesia and a portion of the water as impurities, and assuming the Woskressenskoi volborthite to be a combination of vanadates of barium, calcium and copper, with hydrate of copper and water of crystallization, we arrive at the following formula, closely agreeing with the analyses:

Volborthite $= (\frac{1}{8}\ Ba\ \frac{3}{8}\ Ca\ \frac{4}{8}\ Cu)_3\ V_2\ O_8 + 3\ Cu\ H_2\ O_2 + 12\ H_2\ O.$

It will be seen that volborthite is closely allied to psittacinite (Am. Journ. Sc. [3] XII., 36), the formula of which I give for comparison:

Psittacinite $= 2\ (\frac{3}{4}\ Pb\ \frac{1}{4}\ Cu)_3\ V_2\ O_8 + 3\ Cu\ H_2\ O_2 + 6\ H_2\ O$;

the difference being that the latter mineral contains twice as much $R_3\ V_2\ O_8$ and half as much water of crystallization; and lead in the place of barium, calcium, and a portion of the copper.

UNIVERSITY OF PENNSYLVANIA,
PHILADELPHIA, August 1st, 1877.

The Flow of Water Through an Opening in a Pierced Plate.

By Robert Briggs.

(*Read before the American Philosophical Society, August* 17, 1877.)

At the meeting of the Society on the 3d of November, 1876, I presented an hypothesis of the origin of the form of the *vena contracta* under certain conditions stated in the paper then offered. It was shown that on the assumption that the efflux occurred from the layer or strata of water under greatest pressure of water column, at the maximum velocity due to that column, the least section of the vena contracta would have half the area of the opening of efflux, provided the effect of frictional adhesion of the water to the bottom of the vessel and the effect of the internal friction or viscosity of the water were not considered. And it was noticed that the effect from these causes *tended* to enlarge the least section of the vein and increase the quantity of effluent water.

Referring to the words of the paper: "If however there is admitted to exist a certain adhesion to the bottom of the vessel or to the surface or the edges A A, so that the velocity of a particle on A B is less than that fully due to the head; the surface (d) would then become larger than ½ D, the dimension C A would be properly increased to give a corresponding area of efflux, and the conoid Z would also have such contour as would permit the uniformity of flow of each and every particle of the liquid at unchanged velocity, in any section of the vena contracta transverse to the flow. This increase of dimension of the cross section d, and the effect of the descending pencil in accelerating the flow through it, can be taken as sufficient to account for Weisbach's observed value of d = 0.8D, and the position of the plane of least section will be found at about ½ D below the orifice as has been before quoted."

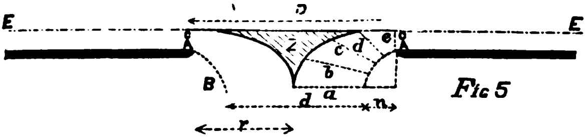


Fig 5

A further illustration of this subject can be instituted by accepting the observed value of the least section of *vena contracta*, which is found to be 0.64D in place of the hypothetical one of ½ D, and by deducing the form of the effluent vein backwards to the strata of water under greatest pressure. Thus, let it be supposed that Fig. 6 represents (as in Fig. 5) an opening in a thin plate, guarded or protected by a Disc Z, of such contour and so placed that a current flowing towards the opening shall obtain the maximum velocity due to the head, and be diverted from its horizontal to the vertical direction without change of velocity of any particle of the current. The contour of the vena contracta from

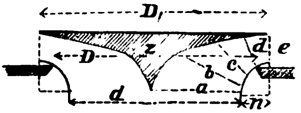


Fig 6

the edge of the aperture to the plane of least section is taken to be an arc of a circle—the internal surface of a segment of a ring. Let D be the diameter of the opening in the plate. Suppose d, the diameter of the least section of the *vena contracta*, to have the value given by observation, d = 0.8D. Then following the previous conditions of form of the conoid Z we have, the diameter of the Disc = D_1 = 1.13137D, and the radius of the arc of contour = n = 0.16569D. It will now be observed that the line of the arc of contour, if it is continued within the opening to supposed point of horizontal efflux—the circle of periphery of the disc, gives a strata of water f (shown more distinctly in Fig. 7), which is cut off from the effluent stream. This strata has its greatest thicknesss of f = 0.01358D. These suppositions place the plane of least section = 0.152D below the opening.

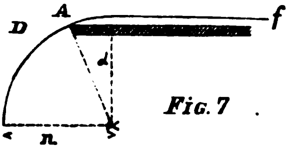


Fig. 7

In Fig. 8 will be seen similar delineation of the contour of the *vena contracta*, and the lines of the current of maximum constant velocity, as modified by placing the plane of least section at its observed position, or 0.25D, below the opening in the plate. The contour of the *vena contracta* is here depicted as an arc of an ellipsis which has 0.166D for its minor radius and 0.275D nearly for its major one, which will approximate closely to the true parabolic form as suggested in the first paper. The thickness of the film or strata f which represents the resistance arising from friction of water against the bottom and at *the edge* of the aperture now becomes about 0.025D. The angle *a* which the current makes with the edge of the aperture becomes about 35°.

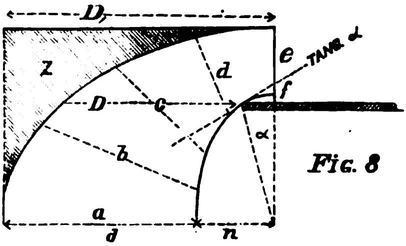


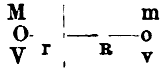
Fig. 8

If these suppositions are correct, a re-entering mouth-piece, shaped to conform to the upper part of the elliptical arc would give the same contour and sections to the *vena contracta* as that now found to proceed from free discharge at a plain aperture. It would seem also from the tenor of this discussion that by substituting a re-entering curve at A fig. 7, making the bottom of the vessel to conform to a reversal of the curve A f, giving the *reversed* elliptical arc *a* at the edge of the orifice, so that the tangent of the curvature upwards at the edge should be about 35°, we should then obtain the theoretic least section from a frictionless horizontal surface of = half the area of the opening. And that such a form would be equally effective with the re-entering tube of Mr. Froude, in giving the current at the edge of the aperture its horizontal direction of least resistance accompanied by the greatest liquid pressure.

The Deviating Forces of an Unsymmetrically Balanced Fly-wheel.

Mr. Briggs mentioned that he had not found in the text books of applied or practical Mechanics—Morin, Rankine, Weisbach, Fairbairn or others—any proper consideration had been given to the strains on the axis of a fly-wheel, which, correctly balanced with regard to the gravity of its masses, and also in the plane of rotation, yet without symmetry of position or mass of the balanced parts, is then accelerated or retarded to meet the usual requirements of a regulator of power. The fact that a fly-wheel must be balanced in one plane to run without vibratory effect at any given speed and when thus balanced the centrifugal forces of the parts will be in equilibrium and the axis permanent is fully stated by all recent writers, but the condition of permanency of axis when an unsymmetrically balanced fly-wheel gives out or absorbs force has not been discussed.

The following elementary case shows the proposition distinctly: Let it be supposed that a fly-wheel were formed of a pair of unequal weights at the extremities of arms (radii) of such length as will place the axis in the centre of gravity of the system, thus:



Where M m = the masses and r R = the radii. Let V_1, V_2 and v_1, v_2 represent the two velocities. The admitted energy from the change of velocities of the masses is thus expressed by the equation—

$$F = \left[M(V_1^2 - V_2^2) + m(v_1^2 - v_2^2)\right] \div 2g \qquad (1)$$

But from the condition of balancing $m = M\frac{r}{R}$; $v_1 = V_1\frac{R}{r}$; and $v_2 = V_2\frac{R}{r}$

$$\therefore\ F = \left[M(V_1^2 - V_2^2) + M\frac{r}{R}[V_1^2(\tfrac{R}{r})^2 + V_2^2(\tfrac{R}{r})^2]\right] \div 2g \qquad (2)$$

$$F = M\left[(1 + \frac{R}{r}(V_1^2 - V_2^2)\right] \div 2g \qquad (3)$$

Showing that the ratio of force given out by the two halves of the fly-wheel under any change of velocity, during any instant of time, will be unity, and the axis be in equilibrium, when $1 = R \div r$ and in no other case, and the masses and velocities become equal in the same case.

This condition of unsymmetrical balancing of fly-wheels is by no means an unusual one. The castings of fly-wheels of steam engines and more especially of pulleys for transmission of force which act generally more or less as fly-wheels, are rarely of such uniformity as not to require balancing,—nearly always done on the rim of the wheel, regardless of point of inequality, which is more frequently in the arms than in the rim.

Perhaps the most striking instance is the case of the vertical blowing engine, where the whole weight of the pistons, crossheads and rods rests upon crank pins inserted in the arms of two fly-wheels at points from one-fourth to one-third the radii of the rim, which weight is counteracted by a suitable load at the rim opposite the crank pins. It is then found that much less load is needed to give comparative steadiness of motion than what would be required to balance the parts, and that the blowing engine must be balanced to run at a given speed and thus be liable to definite changes of motion of the fly-wheel each stroke. In all steam engines with single cylinders it must be recognized that during an instant of the stroke, the fly-wheel must, solely and unaided, maintain the speed and give out the whole power of the engine *by retardation*, while in most engines, during a considerable portion of the stroke, the fly-wheel is aiding, or assisting to impel, the shaft of transmission ; of course receiving a corresponding impulse from other portions of the same stroke.

The unbalanced forces which result from changes of speed of rotation of these unsymmetrical wheels, are transformed into pressures at the axes and have to be sustained by the bearings and resisted by the frame works which carry or support the same, in addition to any strain, proceeding from the mechanism employed in giving rotation or in transmission of power. As pressure or load upon the bearings, the increment of heat derived from friction may cause the total heat to surpass the limit of dispersion in cases where the direct weight of the fly-wheel, approach, as they frequently do, the maximum load of practical endurance on the bearing surfaces. The apparently unaccountable heating of some fly-wheel bearings, where the absolute pressures from load or work are not so great as to cause heating, has been noticed by all practical mechanics, and the considerations now presented offer a reasonable hypothesis in explanation.

In Mahan's Moseley's Mechanics will be found some mathematical investigations leading in this direction, see appendix notes D and E, but a study of these forces and an application of the theorem to the special case of a fly-wheel regulating force or power is needed to complete the theory of practical mechanical construction.

Description of the Wilcox Spouting Water-Well.

BY CHAS. A. ASHBURNER, M. S., ASSISTANT GEOLOGICAL SURVEY.

(*Read before the American Philosophical Society September* 21, 1877.)

The Wilcox Spouting Water-Well for the last nine months has attracted considerable attention, from the immense columns of water and gas which are periodically (every seven minutes) thrown up into air to a height of from 85 to 115 feet. The well is located in the valley of West Clarion Creek, just north of the southern boundary of McKean County, Pennsylvania, and five miles north of Wilcox, a station on the Philadelphia and Erie Railroad 104 miles east of the City of Erie.

The history of the well may be briefly stated as follows :

The Wilcox Well No. 1, or the old Adams Well, was drilled in 1864 (?)

to a depth of 1618 feet, and afterwards continued to a depth of 1785 feet,* where the tools which still remain in the hole, were lost.

The elevation of the top of the conductor above the railroad bridge at Wilcox is 120 feet or 1629 feet above the mean level of Atlantic Ocean. †

The well was drilled "wet," that is, no effort was made to keep the water encountered in the upper part of the hole from following the drill. Great difficulty was experienced in drilling on account of a heavy water vein which was struck at 60 feet depth. This was more particularly the case after the gas veins at 1200 and 1600 feet respectively were met. The water would flow into the hole on top of the gas which it would confine until the pressure of the latter became so great that a huge column of the water would be thrown out of the hole to the annoyance of the drillers. This occurred periodically.

After the tools were lost the upper 400 feet of the well was cased with a four inch casing having a water packer or seed bag attached to its lower end, effectually excluding the water and rendering the hole practically dry.‡

The well was then tubed and it is reported that as much as 100 barrels of oil was pumped and shipped to market; but on account of the great expense of procuring the petroleum, the hole was finally abandoned and the gas allowed free escape into the open air. The gas was afterwards fired and the derrick burned. Three or four years ago a wooden plug was inserted into the casing, which only permitted a partial escape of the gas.

About the beginning of the year 1876, when Well No 2 was started 900 feet distant, a pipe connection was made with Well No. 1, and the gas used as fuel in drilling Well No. 2. The surplus gas was conveyed through a U shaped tube and discharged over a water tank, the water being splashed by the gas over the orifice of the pipe. The pressure of the gas being thus suddenly relieved a ring of ice an inch thick was formed, which remained under the warmest sun. The ice in this case was produced naturally on the same principle that governs the operation of the Kirk freezing machine.

From the time the gas was first struck by the drill up to the latter part of 1876, it seemed to have, according to Mr. Schultz, a constant flow, but as no measurement was made of its pressure it is probable that it gradually diminished.

A little oil being found in Well No. 2, an inch pipe was inserted at the depth of 2000 (the well being 2004 feet deep), and it was proposed to utilize the pressure of the gas to force the oil out of the tubing. The resistance

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* Authority, Mr. M. M. Schultz, of Wilcox.

† The elevation of Wilcox being 1509 feet according to railroad levels made subsequent to 1862.

‡ For a complete record of the Well see a paper, by Prof. Lesley, in the Proceedings of the American Philosophical Society, Vol. X., page 238; also one in the Petroleum Monthly of a later date.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Number of observations.	Gas ceases to flow and water commences running in.	Interval.	Water ceases to run in and gas commences rising.	Interval.	Column (of water and gas) commences rising.	Interval.	Column attains maximum height.	Interval.	Height.	Number of pulsations.	Column vanishes.	Interval.	Water ceases to run in and gas commences rising.	Interval.	Column commences rising.	Interval.	Column attains maximum height.	Interval.	Height.	Column vanishes.	Interval.
1					1.24.30	.15	1.24.45	1.	101		1.25.45	1.35	1.27.20	.45	1.28.05	.10	1.28.15	.30	3	1.28.45	1.15
Interval.					6.30		7.15				7.15		7.10		7.35		7.35			7.30	
2	1.30.	.55	1.30.55	05	1.31.	1.	1.32	1.	99	4	1.33.	1.30	1.34.30	1.10	1.35.40	.10	1.35.50	.25	2½	1.36.15	
Interval.					7.		7.				6.50		7.		6.35		6.40			6.55	
3	*		†		1.38.	1.	1.39.	.50	87	3	1.39.50	1.40	1.41.30	.45	1.42.15	.15	1.42.30	.40	2½	1.43.10	.55
Interval.	14.05		14.05		7.15		7.				6.55		6.45		6.05		6.30			6.20	
4	1.44.05	55	1.45.	15	1.45.15	.45	1.46	.45	87	7	1.46.45	1.30	1.48.15	.05	1.48.20	.40	1.49.	.35	5	1.49.30	1.20
Interval.	6.45		7.		6.55		6.40				7.		7.		7.25		6.45			7.15	
5	1.50.50	1.10	1.52.	10	1.52.10	.30	1.52.40	1.05	83	6	1.53.45	1.30	1.55.15	.30	1.55.45	.10	1.55.55	.50	8	1.56.45	1.
Interval.	6 55		6.50				6.35				6.55		7.		7.20		7.25			7.15	
6	1.57.45	1.05	1.58.50		———		1.59.15	1.25	99	6	2.00.40	1.35	2.02.15	.50	2.03.05	.15	2.03.20	.40	2½	2.04.	
Interval.					13.35		7.				6.40		6.45		6.35		6.30			6.45	
7	*		†		2.05.45	.30	2.06.15	1.05	86	4	2.07.20	1.40	2.09.	.40	2.09.40	.10	2.09.50	.55	2½	2.10.45	.50
Interval.	13.50		13.45		7.		7.				6.55		6.45		6.50		6.55			7.	
8	2.11.35	1.	2.12.35	10	2.12.45	.30	2.13.15	1.	91	5	2.14.15	1.30	2.15.45	.45	2.16.30	.15	2.16.45	1.	4	2.17.45	.35
Interval.	6.45		6.40		6.35		6.45				6.45		6.45		6.40		6.35			6.45	
9	2.18.20	.55	2.19.15	05	2.19.20	.40	2.20.	1.	115	6	2.21.	1.30	2.22.30	.40	2.23.10	.10	2.23.20	1.10	5	2.24.30	.35
Interval.	6.45		7.05		7.05		7.				7.										
10	2.25.05	1.15	2.26.20	05	2.26.52	.35	2.27.	1.	97	6	2.28.										

* The gas did not cease to flow, but rose continuously between the smaller and larger columns.

† The water did not flow in from the pool surrounding the top of the conductor.

offered to the flow of the gas was so great that after a few hours the gas ceased to flow entirely from both wells, Nos. 1 and 2. After 36 hours of inactivity it commenced flowing again with greater energy. In the early part of January, 1877, the pressure of the gas seemed to increase suddenly; but not finding a free passage from Well No. 1, on account of the wooden plug which had been inserted into the casing and which the gas was unable to blow out, the casing was broken at a depth of 175 feet, and the upper portion lifted bodily out of the well. As soon as this occurred the conditions which had existed during the process of drilling were restored, and a column of water was thrown out of the hole every eight minutes to a height of from 80 to 90 feet, and lasting from three to five minutes (M. M. Schultz). This continued until about the middle of May, when the gas from both wells ceased to flow without any obstruction having been knowingly placed in its way.

On the 14th of July, at 1 A. M., the gas made its appearance again and began to throw the water with great energy to a height ranging from 85 to 115 feet; also with a smaller column from three to eight feet high in the intervals between the larger ones; the phenomenon recurring every seven minutes.

During the time that the water columns are thrown out of the well the gas is thoroughly mixed up with the water and is readily ignited. The sight during the flow of the larger column is grand, particularly at night. The water and fire are so promiscuously blended that the two elements seem to be fighting for the mastery.

On July 19th, I closely watched the well for two hours, from 1.19 to 3.22 P. M., and carefully recorded the time of each change in the condition of the water and gas as they spouted from it, noting the number of pulsations in the larger column, and determining its maximum height by triangulation.

On page 129 is a tabulated scheme of the observations from 24 minutes and 30 seconds past one to 28 minutes past two o'clock.*

By an inspection of the intervals between the recurring phenomena, it will be at once seen that there is a marked regularity in the action of the well; in fact, the slight irregularities observed may in a measure be attributed to the personal equation of the observer. In the time included from 10.39 A. M. to 3.15¾ P. M., there were counted 39 of the larger water columns, making the average time between the commencement of each column 6 minutes and 55 seconds.

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*NOTES.—1. The time in the table is recorded in hours, minutes and seconds, and the height of the columns in feet.

2. The intervals in the vertical columns show the time in minutes and seconds or seconds alone, during which each phenomenon lasted. The intervals in the horizontal columns show the time in minutes and seconds between the recurrences of the phenomenon.

3. In columns Nos. 4 and 14, where it is stated "the water ceased to run in," it is meant that no water flowed into the hole from the pool surrounding the top of the conductor. It is probable that the water from the water vein at 60 feet depth flows into the well incessantly.

The accompanying graphical representation will present the action more vividly to the eye. It will be noticed that prior to the water columns No. 3 and 7 no water flowed into the hole from the pool surrounding the conductor. Directly after the larger columns vanish, the water flows into the hole, indicating that all the water is blown out of the well.

Occupying every consecutive 7 ± minutes we have the following sequence of events (See observation No. 9 of the table):

The water from the "water vein" at the depth of 60 feet, and from the pool surrounding the top of the conductor flows into the well for 55 seconds, during which time no gas is detected issuing from the hole. At the end of this time the water from the pool ceases to run in, and the gas rises bubble by bubble for 5 seconds. A column of water and gas now commences rising, makes 6 pulsations, attains a maximum height of 115 feet in 40 seconds, and vanishes in 1 minute. The water from the pool and water vein immediately flows into the well for the second time, continuing for 1 minute and 30 seconds, during which time no gas flows out. At the end of this time the gas rises bubble by bubble for 40 seconds, when the smaller column of water and gas rises, attaining a maximum height of 5 feet in 10 seconds, and vanishes in 1 minute and 10 seconds. The gas still continues to rise but no water flows into the well from the pool for 35 seconds, when the same series of phenomena repeat themselves. Such are the facts.

The explanation of the action may be readily imagined. The pressure of the gas having relieved itself in throwing out of the well the larger column, the water flows into the hole until the pressure of the gas becomes so great again that instead of rising up in small bubbles through the water it rushes out of the well, throwing the water at the same time to a height of from 3 to 8 feet. After the column has vanished the gas continues to rise in great quantities, keeping the water from flowing in from the pool, until the pressure is exhausted. The water now flows into the well till the pressure of the gas in its reservoir has increased to such an extent that it thrusts out of the hole the larger column of water to a height of from 85 to 115 feet.

The smaller column of water is probably produced by the gas coming from the smaller vein at 1200 feet depth, while the larger column is thrown up by the gas coming from the greater vein at a depth of 1600 feet. But, of course, neither the one nor the other column is produced by either of the gas veins exclusively, for the gas must be flowing from both horizons more or less all the time. It will be noticed that more water flows into the hole directly after the larger column has been thrown up, and that the smaller column throws up less water, and *vice versa*.

It was not possible to obtain the pressure or amount of gas coming from the well. The estimated pressure at the time that 175 feet of casing was blown from the well was about 250 lbs. to the square inch. It is possible that the accumulated pressure at the time that the larger water columns are thrown up may be as high as 250 lbs.; but the constant pressure of the gas if unobstructed by the water would probably not be more than 50 lbs.

The action of the Wilcox well is nothing novel, but the observations are interesting and valuable from the fact that a complete record and history of the well have been preserved, and the accompanying facts add much to what has been recorded of similar wells.

As early as 1833[*], Dr. S. P. Hildreth, in a paper on the "Saliferous Rock Formation in the Valley of the Ohio" says: "In many wells, salt water and inflammable gas rise in company with a steady uniform flow. In others, the gas rises at intervals of ten or twelve hours, or perhaps as many days, in vast quantity, and with overwhelming force, throwing the water from the well to the height of fifty to one hundred feet in the air, and again retiring within the bowels of the earth to acquire fresh power for a new effort. This phenomenon is called 'blowing,' and is very troublesome and vexatious to the manufacturer."

A well drilled by Peter Neff, Esq., near Kenyon College, in Knox Co., Ohio, presented similar features to the Wilcox well. At a depth of 600 feet gas was struck which threw out of the well at intervals of one minute, a column of water to a height of 120 feet. "The derrick set over this well has a height of 60 feet. In winter it becomes encased in ice, and forms a huge translucent chimney, through which, at regular intervals of one minute, a mingled current of gas and water rushes to twice its height. By cutting through this chimney at the base and igniting the gas in a paroxysm, it affords a magnificent spectacle—a fountain of water and fire which brilliantly illuminates the ice chimney."

Many of the persons who have visited the Wilcox well during the summer have made a comparison of heights with geysers of the Geyser Basin, and I have been repeatedly referred to for information in regard to the latter.

The following table, compiled from Dr. Hayden's report of the U. S. Geological Survey, 1871, gives some figures of the geysers along the Fire Hole River, in Wyoming Territory.

Name.	Height.	Diameter.	Time.	Observer.
Grand.....	200 feet.	6 feet.	20 minutes.	Dr. Hayden.
Giant.....	140 "	5 "	3 hours.	N. P. Langford.
"	90 to 200 ft.	———	3 hrs. 30 min.	Lieut. Doane (1870)
"	140 feet.	———	1 " 20 "	Dr. Hayden.
Giantess...	250 "	6 to 15 in.	20 minutes.	" "
Beehive ..	219 "	———	18 "	" "

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[*] See American Journal of Science, July, 1833, quoted in Early and Latter History of Petroleum, by J. T. Henry.

Note.—Since writing the above it has been reported to me that the gas in well No. 2 has been partly confined, and the increased pressure in well No. 1 has somewhat altered the action of the water and gas. The large column is thrown to a greater height.

Discussion.

Mr. Briggs remarked that the conditions which produce the phenomena of Spouting Wells and of Geysers are sufficiently simple but perhaps not generally comprehended. One of the essentials for the peculiar eruption and periodic discharge which they exhibit, is the enlargement or funnel shape of the upper portion of the cavity; so that at or near the final effort of each pulsation, the confined gas or steam shall be suddenly relieved of a part of the pressure of column or head, and the gas or vapor beneath the liquid, in so large a bubble as to form a chamber or reservoir of gas or steam, be allowed to expand against a less pressure than that under which it had generated or been supplied when lifting the column from the bottom of the well to the place where the well enlarged.

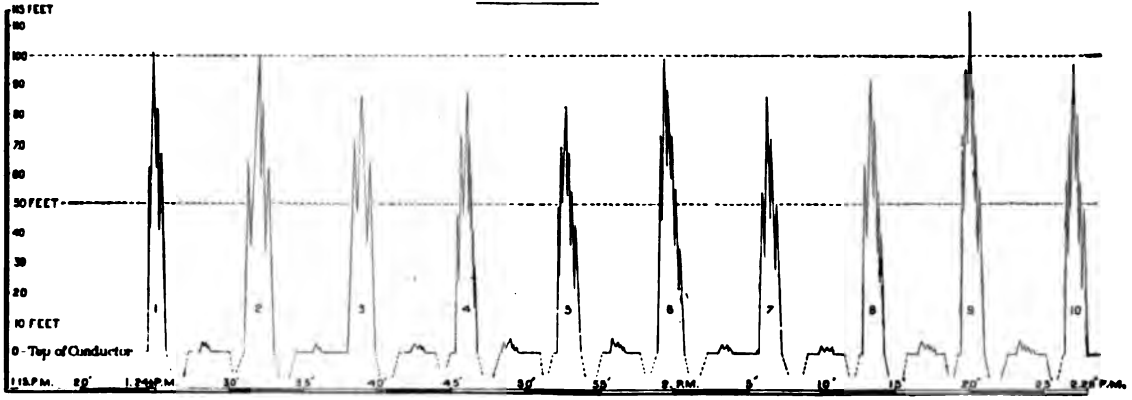
By tracing the phenomenon of a single pulsation, as it may be assumed from the foregoing description to have occurred, it will be seen that, commencing with that period when the gas has exhausted its pressure by a nearly free discharge, after the complete expulsion of the water and relief from any resistance except that proceeding from the depth of water in the shallow pool formed about the mouth of the well (presumed to be from 1 to 2 feet in depth at most), after the pressure of gas falls below this presumed depth, the steps in operation are as follows: A portion of the water in the pool at the top flows back upon the well, quickly forming a column within it and compressing the gas beneath, which is in much too large volume to rise through the water in small bubbles, although some bubbles may force their way up when the return of water first begins and discharge eruptively as they approach the surface, lifting a spatter of water at such discharge, but finally the water column will have acquired such height as to flow quickly down the well and receive such augmentation of quantity as the water bearing strata may supply, filling the well nearly to the bottom, some considerable portion of solid water passing below the level of the upper gas bearing strata and compressing the lower gas by the momentum of the water to the point where its gas supply may be stopped from flowing. Possibly a bubble of gas from the upper gas bearing strata will be formed in the column and be carried downwards, as there is 400 feet of depth of well between these two strata and we can scarcely conceive of 400 feet of solid water, or even 300, to reach between the two levels; but at all events a column of water of some height exists between the upper and lower gas strata when the ultimate recession of water into the well has occurred. The gradual supply of gas from both sources of supply now overcomes and slowly elevates the mass of water, however broken by gas bubbles, giving a nearly uniform pressure of column during such time as it is elevated in the tube (or well) of uniform section, that is until the column reaches the point where the casing was blown out; there being a great bubble of confined upper as well as a volume of confined lower gas in the bore of the well. Ultimately, before the column reaches the point of enlargement, the volumes of gas become much more considerable than those of the water. It may be assumed, as it is essential to do for the resulting expulsion, that of the 1400 feet (about) of total depth below the top of the casing not over 300 or 400 feet of water column (if so much) ever exists in the well. The water which up to this stage has ascended slowly, now rises into the enlarged mouth caused by the absence of casing, and relieved from pressure of column, as the height reduces, the expanding gas of the upper bubble, becomes eruptive, and the first discharge of 3 or 4 feet height of water is effected. The relief of pressure attendant upon the removal of a portion of the water above into the pool, lifts the lower column of water to above the upper gas bearing strata; but before it reaches the enlargement at the casing the force of expulsion of the upper bubble will have been expended, and the water thus discharged will have returned wholly or in part to the well again, and will have restored the original column and its pressure upon a larger volume of gas with the supply of both gas bearing strata. The regular supply of gas continuing, the column again reaches the point of enlargement, and now, with a great reservoir of gas to expand, the final effort of a pulsation is consummated, with a discharge of gas and water of 85 to 115 feet in height. Allowing for the mixture of gas and water in reducing the gravity of the column, it is possible that the greatest *pulsation of emergence* at the mouth of the well cannot be more than the equivalent to a height of 60 to 90 feet or 30 to 45 pounds per square inch.

In the case of the Geyser the same necessity of conformation of the pit or hole, so far as regards the funnel-shaped mouth to relieve the pressure of water column at or near the top, exists. The heated water is then the reservoir of energy for producing an eruption; a large volume of steam being formed at once when relief of pressure occurs. The phenomena of periodic discharge following a course similar to that described as coming from emission of gas from a strata when the cooled return water comes in contact with the volcanic heated rocks at the bottom of the hole, producing a steam pressure more rapidly than the water circulation will permit the heat to be transferred to the surface of the water quietly and thus lifting the column to the point of enlargement where its pressure is reduced.

Proceedings Amer. Philosoph. Society, Philadelphia. Vol. XVII. page 127 Plate III.

Graphical Representation of the Wilcox Spouting Water-Well, McKean Co. Pa.

The unbroken line on and above the base is the profile of the Water issuing from the Conductor; the Gas rising from the Well at the same time. The broken line below the base indicates the time that no gas is issuing from the Well, and the time that the Water from the Pool around the Conductor is flowing in. The height of the major pulsation in each column was alone determined.



Observations made July 19th 1877, by Chas. A. Ashburner, M.S. Asst. Second Geological Survey of Pa.

Level Notes and Compass Courses of the Seaboard Oil Pipe Line, from the the Mouth of Black Fox Run, in Clarion County, Pa., to Patapsco River, near Baltimore, Md. Lines run by O. Barrett, Jr., C.E., Western Division; B. F. Warren, C.E., Middle Division; J. B. Haupt, C.E., Eastern Division.

GEN. H. HAUPT, CHIEF ENGINEER.

(*Read before the American Philosophical Society, October 5th,* 1877.)

The Seabord Pipe Line survey line commences in the Oil Region of Western Pennsylvania, in the Valley of the Alleghany River, at a point one and a-half miles below (south of) Monterey Station on the Alleghany Valley Railroad; takes a nearly straight course over the high lands of Indiana and Cambria Counties; descends the face of the Alleghany Mountain; crosses the mountains and valleys of Middle Pennsylvania; the South Mountain range; the red sandstone plain in front of them, and the hills of Middle Maryland to Baltimore; a total distance of about 228 miles, = 1,202,828 feet.

It passes about fourteen miles south of the county town of Indiana; one mile south of Carrolton in Cambria County; crosses the Pennsylvania Railroad at Elizabeth Furnace; the Broad Top Railroad at McConnellstown; passes through Orbisonia, Shade Gap, Roxboro', Shippensburg, Gettysburg; passes one mile south of Littlestown; two and a-half miles south of Westminster; one mile south of Reisterstown; follows the ridge between Patapsco Falls and Guyron's Falls, and terminates on Curtis' Bay two miles south of Canton, on an inlet of Chesapeake Bay at Baltimore.

REMARKS.

In the column marked △ the distance from starting points B M are given in feet, measured on the ground (not horizontally).

The elevation is given in the second column in feet and hundredths.

NOTE. The decimal point in the 1st, 5th and 7th columns divides the distance into lengths of 100 feet. Thus: 98.35 = 9,835 feet, &c.

The courses given in the second column show the general direction. The line run varies from the general direction in many places, but is seldom more than from one to two hundred yards to right or left of the general course, and in most cases less.

The distances in the fourth column are the distances of a number of shorter courses taken by scale from the plot.

The columns of Maxima and Minima give the undulations, being ordinates at extreme elevations and depressions, or where there are changes in the slope of the ground.

Any further information desired may be obtained from B. F. Warren, 734 N. 20th Street, Philadelphia.

The degrees and minutes of courses begin with 0° at north, running 90° =E; 180°=S; 270°=W, &c.

Δ	*Elev.*	*Course*	*Dist.*	MAXIMA.		MINIMA.		
				Δ	*Elev.*	Δ	*Elev.*	
B M	807′.45	Elevation of surface of water in Alleghany River at mouth of Black Fox Run.						
0.00	824.20	87½°	9155′	39.30	1143′.2	50.90	1110′.6	Entrance to McElroy's Coal Mine.
				91.90	1343.6			
98.35	1231.8	118½°	20010′			100.00	1212.0	Creek.
				121.00	1500.1	127.80	1445.9	
				132.45	1496.7	168.00	1210.0	
				170.95	1222.3	178.95	1218.6	
				184.45	1219.1	204.25	1100.0	Catfish Run.
				211.90	1212.8	215.10	1209.7	
				218.15	1212.8	227.50	1185.0	
				235.80	1222.2	242.00	1184.0	
				246.10	1210.0	250.15	1198.6	
				266.15	1252.9	270.50	1235.0	Catfish Run.
				283.80	1290.1	294.70	1271.0	*New Athens.*
				¼ mile to right.				
				314.05	1436.8			
315.70	1420.00	128°25′	39230′			321.50	1280.0	
				331.60	1413.8	337.10	1290.0	Small Run.
				346.90	1419.0	354.75	1350.0	
				360.50	1410.7	368.10	1273.0	
				378.85	1368.6	389.00	1146.0	
				390.90	1182.5	408.15	1049.7	
				418.35	1092.5	439.60	946.0	Turkey Run.
				441.50	984.7	445.30	923.4	ditto.
				450.55	949.3	456.85	848.0	ditto.
						461.00	839.0	Red Bank Creek.
				Line between Clarion and Armstrong Counties.				
				488.00	1219.6	495.20	1083.0	
				504.05	1222.9	509.80	1158.0	
				518.85	1352.3	526.50	1280.0	
				539.40	1384.1	557.00	1055.0	Creek.
				566.65	1375.6	574.00	1198	Run.
				674.55	1525.4	687.40	1356	Creek.
				694.30	1448.0	701.35	1275	
				707.50	1352.0	730.15	997.0	Br. of Mahoning Cr.
731.75	1038.5	126°05′	31030′	736.15	1205.6	740.10	1090.0	Creek.
				762.95	1376.0	784.00	1125.0	Creek.
				811.50	1309.0	824.00	794.5	Mahoning Creek.
				926.75	1450.9	undulating		to
				1011.05	1498.0	1025.40	1276	
				1033.50	1352.0			
1044.60	1290.0	102°45′	16430′	1078.90	1505.6	1085.60	1457.1	
				1098.80	1540.0	1130.50	1371.0	
				1159.90	1550.0	1227.65	1329.0	
1214.10	1401.0	116°10′	18640′	1247.50	1413.0	1260.90	1303.0	
				1266.35	1384.0	1270.75	1257.0	Glade Run.
				1304.30	1350.0	1323.40	1255.0	
				1346.55	1405.0	1359.90	1287.0	Spring Run.
				1377.00	1460	Line of Arm		strong and Indiana Count's
				1387.75	1495	1411.00	1394	
1407.10	1400.0	129°35	42860′	1422.70	1468.0	1460.00	1345	
				1467.00	1372.0	1473.00	1286	Run.
				1486.80	1406.0	1502.30	1257	
				1507.60	1265.0	1511.00	1247	Run.
				1521.30	1503.0	1530.35	1230.0	
				1537.00	1279.0	1540.25	1187.0	Run.
				1547.00	1351.0	1552.80	1365.0	
				1561.30	1469.0	1571.25	1285.0	
				1577.60	1365.0	1586.50	1193.0	
				1599.20	1387.0	1610.40	1224.0	
				1615.25	1247.0	1625.50	1201.0	
				1638.40	1224.0	1663.70	1208.0	
				1682.55	1274.0	1686.00	1214.0	
				1690.40	1332.0	1692.30	1173.0	
				1725.20	1301.0	1735.75	1270.0	
				1745.20	1358.0	1749.70	1238.0	
				1757.20	1331.0	1771.00	1227.0	
				1781.00	1383.0	1785.00	1295.0	

△	Elev.	Course	Dist.	MAXIMA.		MINIMA.		
				△	Elev.	△	Elev.	
				1789.80	1344.0	1794.40	1303.0	
				1802.35	1500.0	1817.75	1259.0	Run.
1842.80	1400.0	121°10′	32090′	1847.30	1415.0	1863.15	1258.0	
				1881.45	1328.0	1885.00	1289.0	
				1898.40	1360.0	1906.55	1328.6	
				1911.20	1336.0	1917.00	1260.0	
				1924.00	1341.0	1931.00	1246.0	
				1950.50	1295.0	1955.00	1277.0	
				1989.65	1484.0	2002.60	1399.0	
				2018.75	1536.0	2030.80	1467.0	
				2057.30	1680.0	2073.75	1595.0	
				2078.15	1621.0	2108.10	1441.0	
				2114.50	1468.0	2126.50	1392	Creek 10′ wide.
				2142.95	1635	2156.10	1425	
				2150.00	1463	2165.35	1384	Two Lick Creek.
2182.90	1480	119°25′	11390′	2206.80	1638	2217.25	1574	
				2228.25	1638	2241.15	1500	Run 4′ wide.
				2253.80	1628	2264.75	1555	
				2272.00	1611	2275.30	1553	
				2281.95	1590	2290.30	1572	Run.
2297.15	1609	169°40′	6540′	2319.80	1671.5	Divide of Two Lick and Mahoning Cr'ks		
2368.50	1433.5	124.10	20690			2372.60	1380	Run.
				2376.15	1440	2407.30	1374	Br. of Two Lick Creek.
				2450.45	1593	2504.80	1527	
				2556.00	1607			
2579.60	1544.7	156°10′	16520′			2521.90	1421	
				2603.30	1557.5	2613.00	1442	Creek.
				2626.15	1625	2640.15	1497	
				2652.95	1666	2661.00	1612	
				2701.05	1962	2710.20	1934	
				2714.60	1959	2732.00	1870	Creek.
				2745.55	1986			
2751.00	1978	129°45′	32020′			2781.65	1831	Run.
				2804.45	1811	2808.50	1786	
				2818.40	1858	2833.55	1807	
				2851.70	1894	2860.00	1868	Creek.
				2882.35	1896	2909.00	1898	
				3019.30	2014	3027.00	1984	Spring.
				3066.95	2096			
3075.80	2055.0	107°40′	13820′			3081.00	2005	
				3143.55	2144	3165.70	2015	
				3171.70	2099	3187.75	2083	
				3200.25	2118	3214.30	2015	
3220.15	2060.9	102°50′	10330′	3233.50	2090	3267.30	2036	
				3277.75	2131			
3324.10	1855	127°30′	6610′			3369.10	1766	Creek.
				nearly level.		3380.00	1757	Same Creek.
						3398.50	1752	Laurel Run.
						3406.00	1751	Chestnut Creek.
				3414.30	1880	3422.00	1754	Run.
				3456.30	1981	3473.40	1814.0	Run.
				3494.00	1917	3500.20	1825	Run.
				3505.60	1876	3514.75	1747	Run.
3515.00	1747.3	88°35′	3480′			3515.75	1744	Same Run.
				3522.40	1765	3524.00	1761	
				3532.45	1990	3550.30	1768	Run.
				level.		3565.75	1687	Creek.
				3581.05	1875	3594.75	1722	Creek.
				3606.65	1877			
3607.90	1859.3	105°30′	12510′			3615.40	1778	
				3630.85	1868	3640.30	1785	Creek.
				3657.15	1868	3669.00	1798	Creek.
						3699.00	1600	Clearfield Creek.
3741.30	1808.5	72°35′	8430′	3765.10	2030	3773.75	1961	
				3796.85	2140	3804.80	2108	
				3824.50	2185			
3826.60	2180	65°30′	7980′	3828.25	2194	3843.30	1910	Laurel Run.
				3862.00	2138	3871.90	2110	
				3888.00	2183	3904.95	1986	Creek.
3906.90	2020.0	62°45′	7805′	uniform rise		3953.10	2256	Creek.

△	*Elev.*	*Course*	*Dist.*	MAXIMA.		MINIMA.		
				△	*Elev.*	△	*Elev.*	
3986.00	2408.0	64°.30′	7315′	4028.20	2537′	4038.40	2464′	Line bet. Cambria & Blair co
						4039.90	2461	
				4054.95	2596			
4059.60	2564	118°.00′	20775′	4064.50	2570	4087.00	2297	
				4092.10	2233	4101.85	1992	Head of Creek.
						4122.15	1722	
				4124.25	1729	4126.30	1663	Creek.
						4133.35	1606	Creek.
				4142.85	1642	4146.50	1627	
				4150.00	1637			
				4154.90	1607	4161.30	1390	
						4181.20	1304	Creek.
						4237.45	1175	Creek.
						4249.00	1154	Creek 15′ wide.
						4256.50	1149	
				4261.10	1175	4272.30	1126	
				4275.00	1138	4282.50	1118	
4287.20	1198	88°.00	4605′	4293.80	1248	4297.75	1222	
				4301.25	1246			
				4310.95	1242	4322.90	1067	
4344.00	1044.6		BM.	M. Div.	=	1056.8		Error = 0′.4.

MIDDLE DIVISION.

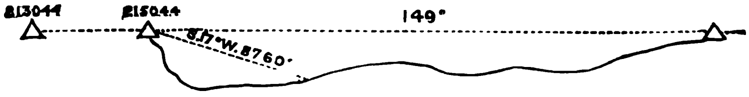
BM. = 1057.2

O.MD	1044.6	110°.45′	11450′	31.40	1089′	34.15	1053′	
						37.15	1053	Creek.
				73.63	1102	94.75	1130	Creek.
				100.87	1158	101.60	1154	Creek.
						107.50	1201	Creek.
115.38	1328.6	75°.45′	7710′	118.82	1415	124.09	1507	
				137.48	1927	140.19	1974	
				156.48	2412	Sum	mit of	W. Brush Mt.
199.48	1731.5	71°.30′	7190′	205.98	1708	219.00	1327	Run.
						240.90	1114	Sinking Valley.
273.93	1104.5	132°.35′	4920′	288.04	1107	300.40	1046	
				313.02	1159	316.10	1141	
323.42	1192.79	127°.15′	28790′			333.60	1272	Run.
						340.40	1347	Run.
						343.59	1395	
				349.34	1667	362.56	1843	
				374.51	2240	Sum	mit of	E. Brush Mt
						415.76	1168	Canoe Creek.
				456.98	1862	460.84	1835	
				470.02	1907	475.47	1903	
				478.60	1940	Sum	mit of	Canoe Mt.
						485.69	1667	
				496.09	1530	504.76	1249	
				507.13	1229	518.00	1083	Run.
				521.09	1136	537.28	1039	
				550.88	1013	553.00	923	
				504.67	1012	578.14	835	Creek.
				582.10	882			
				587.43	927	599.00	780	Roaring Run.
						601.43	746.6	Juniata River.
619.15	821.4	140°.15′	34030′	628.77	886	635.60	740	
				670.60	1340			
				672.70	1364	675.00	1345	
				680.40	1493			
				695.40	1907	Sum	mit of	Tussey Mt.
				715.97	1266	721.38	1259	Creek.
						740.49	1650	
				756.61	2296			
				765.95	2328	Sum	mit of	Tussey Mt.
						780.00	2178	

△	*Elev.*	*Course*	*Dist.*	MAXIMA.		MINIMA.		
				△	*Elev.*	△	*Elev.*	
				782.24	2180′	799.35	1787′	
				805.68	1707	825.85	1143	Run.
						844.00	936	Run.
				856.37	897	863.05	813	
				867.79	920	882.24	791	
				888.07	862	892.40	794	
						905.00	772	
				910.20	868	915.60	772	
				921.54	868	925.00	827	
				930.82	872			
961 37	672.6	161°15′	8530′	*		962.75	650	
☞	See	note	bel'w	975.12	666	1007.40	660	Creek.
						1013.08	630	Creek.
						1031.60	773	
				1035.43	849	1037.53	844	
				1047.14	1137.6	Sum	mit of	Pine Ridge.
1052.28	1072	138°45′	37040′			1067.40	752	
				1074.80	860	1090.38	769	Creek.
				1121.55	993	1126.00	910	
				1132.88	1016	1141.24	912	Run.
				1144.60	1022	1147.70	1013	
				1156.30	1193	1163.04	1050	
				1176.10	1254	1184.00	1019	
				1190.50	1082	1197.90	886	Creek.
				1205.70	1005	1213.20	762	Spring.
				1219.50	819	1256.90	625.3	Raystown Br.
				1285.04	1684	Sum	mit of	Terrace Mt.
						1301.40	1430	
				1304.30	1473	1313.44	1412	
				1320.50	1419	1355.60	1250	Little Trough Creek.
				1368.10	1364	1371.22	1325	
				1391.75	1652	Sum	mit of	Sideling Hill.
				1403.50	1224	1413.37	1100	Creek.
						1425.10	969	Creek.
1429.05	956	140°20′	26375′	1450.92	1242	1461.80	950	Creek.
				1469.20	1054	1474.70	924	
						1481.80	803	Creek in Hares' Valley.
				1495.20	871	1523.36	1269	
				1541.00	1840	Sum	mit of	Jacks Mt.
						1552.50	1653	
				1556.00	1682	1564.70	1631	
				1575.00	1776	1582.80	1582	
				1585.50	1564	1591.80	1513	Creek.
				1611.10	1726	1636.10	1424	
				1637.80	1402	1652.10	1109	
						1657.60	1076	
				1668.70	1083	1679.00	1036	Creek.
1695.74	987	182°30′	11130′	1697.80	964	1784.10	741	Creek.
				1787.54	759			
1815.70	736	155°45′	27700′			1834.70	660	
				1883.10	790	1893.00	670	Gt.Aughwick Cr.
				1930.00	1022	1931.50	960	
				1937.60	1010	1961.20	640	
				1966.00	691	1970.10	708	
				1990.10	692	2006.70	725	Orbisonia.
				2023.70	751	2073.80	726	Rock Hill Gap,
†2130.44	830	149°00′	26690					
☞	See	note	bel'w			2148.30	835	Creek.

*Note.—From △ 975.12 there appears to be a constant error amounting to 161′ at B.M.; this error should be distributed uniformly—as from tests the variation is constant and uniform.

†From 2150.44 the line follows the general direction of the road through Shade Gap and diverges considerably from a straight line, thus:



△	*Elev.*	*Course*	*Dist.*	MAXIMA.		MINIMA.		
				△	*Elev.*	△	*Elev.*	
				2211.50	870′	2244.15	890′	Creek 20′ wide.
				2245.40	903	2255.20	910	Creek.
				2304.70	1094	2322.00	1095	Creek.
				2325.40	1121	2346.70	1097	
				2364.10	1105	2392.60	1111	
						2404.15	1105	Creek.
				2442.90	1150	2451.20	1132	
				2469.10	1167	2475.80	1162	Creek.

If the line be run directly across the mountains on the course 149° it will give the following Maxima and Minima (approximately).

Line across the Mts. from						2150.69	842′	
				2200.00	1770′	2216.20	1325	
				2290.00	1340	2217.00	1020	
				2258.00	1160	2266.50	1070	
				2300.00	1530	2312 00	1380	
						2322.00	1300	
				2328.00	1340	2337.50	1328	
						2342.00	1260	
				2360.00	1500	2377.60	1180	
				2385.00	1220	2475.77	1162	Creek.

2475.77	1162	136° 15′	13230′			2489.40	1249′	
						2503.00	1518	
				2519.10	2060′	2531.20	1601	
						2561.20	1200	Creek.
2618.81	1002	115° 15′	7750′	2645.00	976	2674.20	945	
				2681.00	1002	2694.00	1030	
2697.30	1040	79° 00′	2550′					
2723.20	947	92.30	8930	2737.70	1023	2751.70	1180	
				2758.20	1224	2764.80		Creek.
				2797.00	2020	Kitta	tinny	Mts.
2826.87	1710	119° 00′	17080′	2864.00	1397	2868.60	1250	
				2876.30	1360	2894.30	1377	
						2916.80	1258	
				2920.80	1272	2942.10	949	Conodogwined Creek,
				2944.00	1030	2952.00	942	ditto.
3028.47	895	120° 55′	22720′	3090.80	844	3108.90	844	
				3111.73	865	3139.00	768	
				3146.50	849	3151.00	810	Creek;
				3164.80	855	3175.40	750	Creek.
				3193.00	824	3229.30	700	Conodogwined Creek.
				3260.80	844			
3286.41	840	125° 00′	21320′	3305.30	780	3348.50	873	[berland Counties,
				3400.00	885	3435.70	849	Line of Franklin and Cum-
				3458.80	835	3464.60		Shippensburg.
				3499.30	821			
3499.28	821			BM. E. Div. — 821. Error 161′.				

EASTERN DIVISION.

O BM	659.333	133° 35′	13720′			1140	651′	
				24.00	699′	33.50	671	
				45.70	744	54.00	707	
				63.50	814	79.00	725	
				117.30	773			
				140.00	818			
147.00	856	133° 50′	34830′	188.00	988	207.00	1450	
				211.50	1305	240.00	1130	Creek.
				261.50	1568	278.00	1340	
				348.50	1914	364.50	1861	
				379.50	1953	391.50	1718	Creek.

Δ	Elev.	Course	Dist.	MAXIMA.		MINIMA.		
				Δ	Elev.	Δ	Elev.	
				396.00	1800′	401.00	1718′	
				423.00	1914	427.50	Line	between Cumb. and Adams
						452.00	1425	Creek.
				477.00	1047			
				492.00	1657			
496.50	1635	109°.30′	7035′			523.00	1236	Creek.
				531.00	1282	555.50	1113	
567.00	1112	109°.30′	6880′	574.30	1102	622.00	825	
636.00	863	138.10	26670			660.00	732	Conewago Creek.
				721.00	812	767.00	705	Creek.
				773.80	766			
				816.50	786	829.00	673	
				838.15	728	877.65	671	
				886.50	643	889.20	666	
				895.25	616			
917.37	630	141°.20′	21700′	928.50	654	938.00	613	
				955.00	666	972.20	668	
				987.50	624	1015.00	575	
				1040.70	636	1055.00	525	
						1069.75	495	Creek.
				1077.50	537	1082.35	517	
				1086.50	533	1091.50	496	
				1095.00	514	1103.00	495	
				1108.00	507	1114.60	489	
				1120.00	496	1142.00	461	Strikes Rock Creek.
1145.00	460	175°.30′	10950′	Running along Rock Creek.				
1256.00		155.30	13920	1261.00	480	1275.00	448	
				1284.00	Leaves Rock Creek.			
				1303.00	472	1313.50	550	
				1330.50	568	1338.00	442	
						1351.00	442	
				1363.00	509	1388.60	414	White Run.
1397.18		126°.40′	22300′	1427.50	531	1432.50	508	
				1438 50	528	1443.00	506	
				1447.00	522	1450.00	506	
				1458.00	538	1462.25	528	
				1468.00	535	1472.00	533	
				1479.00	497	1482.50	514	
						1492.40	482	Creek.
				1499.00	524	1533.00	525	Creek.
				1558,00	587	1582.00	510	Creek.
				1606.30	584			
1621.27		136°.30′	28680′			1626.80	515	Creek.
				1658 20	524	1679.70	564	
				1691.40	611	1696.70	585	
				1714.97	641	1718.50	632	
				1735.70	604	1746.20	551	
				1758.10	615	1776.20	547	Creek.
				1778,41	596	1788.40	574	
				1829.70	706	1851.93	605	Creek.
				1856.00	Line bet. Penna. and Maryland.			
						1884.70	638	
				1907.70	731			
1926.16	755	137°.00′	29140′			1937.70	693	
				1943.50	735			
				1952.70	666	1954.25	618	
						1972.70	582	Creek.
				2013.70	790	2022.70	700	
				2025.70	707	2027.20	686	
				2029.70	724	2031.20	700	
				2048.70	792	2050.70	667	
				2069.00	789	2092.00	603	
				2095.70	716	2110.70	576	Creek.
				2120.70	762	2125.70	720	
				2129.25	746	hollow		
				2147.70	718	2150.20	683	
				2164.20	698	2166.70	657	
				2171.20	673	2182.45	587	Creek.
						2186.70	593	Creek.
				2189.70	684	2196.70	607	Creek.

△	Elev.	Course	Dist.	MAXIMA.		MINIMA.		
				△	Elev.	△	Elev.	
				2197.25	620′			
2227.70	706.3	137° 30′	9775′			2229.50	680′	
				2212.70	725	2252.70	676	Creek.
				2256.70	745			
				2264.70	755	2269.70	726	
				2274.00	742	2281.70	674	
				2288.70	751	2291.70	730	
				2297.70	767	2311.70	678	Creek.
2328.70		188° 30′	7150′	2330.20	797	2340.70	739	
				2369.70	880	2382.70	795	
				2390.70	826			
2405.08		152° 05′	27870′			2418.70	732	Creek.
				2443.70	861	2452.20	776	
				2471.45	914			
				2481.00	971	2492.20	870	
				2504.70	891			
				2508.45	906			
				2523.70	874	2532.70	819	
				2540.70	843	2543.70	834	
				2563.70	864	2576.20	803	
				2585.35	813	2598.70	814	
						2632.70	738	
				2644.30	780	2652.70	757	
						2662.70	717	
				2676.70	735			
				2696.70	743			
2697.70		152° 00′	26340′			2702.20	707	
				2722.70	738	2727.70	650	
				2732.70	685			
				2742.20	649	2745.20	585	
				2747.70	620			
				2752.70	644	2762.70	489	E. Br.Patapsco.
				2785.70	652	2798.20	530	Run.
				2799.70	541	2802.45	461	Deep Run.
				2810.00	520			
				2812.70	534	2820.70	467	
				2831.70	612	2838.70	464	
						2841.70	461	
				2846.70	529	2849.00	501	Creek.
				2855.20	604	2859.70	557	
				2865.70	590	2867.70	544	
				2879.70	572	2885.70	552	
						2886.70	511	
				2888.70	540	2908.00	429	Great Run.
						2916.70	453	
				2923.00	526	2924.70	467	
				2928.20	Line	of Ca	rroll	and Baltimore Counties.
				2929.00	532	2938.10	499	
				2943.70	581	2944.70	508	
				2949.70	519	2951.45	473	
				2954.70	537	2957.70	509	
						2959.70	469	
				2976.30	584			
2981.60	522	190° 30′	9400′	3047.10	574	3053.00	475	
						3058.70	474	Creek.
				3068.70	541	3070.70	532	
3077.06		189° 45′	9040′	3077.00	606	3078.00	593	
				3085.20	642	3086.70	626	
				3090.70	633			
				3099.30	634	3113.70	556	Creek.
				3123.70	605	3143.45	568	Run.
				3151.00	671			
				3163.30	688	3169.70	626	
				3173.70	639	3187.70	536	
3188.50	533	167° 00′	9170′			3191.70	511	Creek.
				3204.10	613			
				3210.70	647	3215.20	625	
				3226.40	683	3237.00	600	
				3241.20	620	3248.20	537	
				3265.70	677	3281.70	677	

Δ	Elev.	Course	Dist.	MAXIMA.		MINIMA.		
				Δ	Elev.	Δ	Elev.	
				3284.70	702′	3288.20	659′	
				3291.20	693			
3297.60		149°15′	12510′			3298.70	616	
				3303.70	651	3309.20	600	
				3320.70	698	3345.70	639	
				3352.70	662	3364.00	645	
				3365.50	650	3368.20	641	
				3371.70	659	3381.70	581	
						3393.30	547	Creek.
				3400.70	591	3401.70	567	
				3403.70	590	3407.00	558	
				3413.20	616	3417.00	579	
3428.70	623	142°45′	18890′			3436.20	533	Creek.
				3454.70	622	3464.70	573	
				3472.70	606			
						3480.20	487	Creek.
				3498.70	577	3505.70	564	
				3508.70	578	3512.70	543	
						3532.60	484	Creek.
				3550.70	591	3561.00	589	
				3574.70	593	3580.70	563	
				3585.10	574	3610.70	500	Creek.
				3616.45	514			
3620.70	490.5	107°45′	10500′			3630.70	483	Creek.
				3636.20	505	3641.70	503	
				3649.20	518	3664.70	508	
				3675.70	579	3689.70	501	
				3699.70	518	3720.70	511	
				3739.80	524			
3743.45		172°30′	12820′			3765.20	494	
				3781.70	525	3805.70	478	
				3815.70	481	3847.20	400	
3874.70	450.6	142°00′	16735′			3880.70	439	
				3883.70	449	3901.20	384	
				3911.20	423	3917.45	393	Creek.
				3980.70	510	3998.45	464	
				4002.20	480	4039.20	326	
						4043.70	337	
				4049.70	398			
4050.20	395	127°30′	13070′			4065.70	317	
				4069.70	326	4076.20	288	
				4079.70	315	4099.70	214	
				4109.10	224	4115.10	165	
				4121.70	173	4136.70	95	Creek.
				4050.70	171	4069.70	98	
				4085.70	159			
4185.00		125°40′	15630′	4090.70	234	4213.70	79	
				4221.35	123	4227.40	96	
				4236.20	140	4241.70	83	
				4250.20	158			
				4264.70	147	4285.70	128	Pond extends to 4275.70.
				4281.70	144	4290.70	89	
				4294.70	119	4302.70	61	
				4310.55	125	4346.70	0	Patapsco R., about 6 miles below Baltimore.

List of Elevations, above Mean Tide, through the County of Indiana, in Pennsylvania, copied from Notes of Survey under Gen. H. Haupt, for the Sea Board Pipe Line.

By O. Barrett, Jr.

(*Read before the American Philosophical Society, October 5th,* 1877.)

Stations.	Elevations.	Trees, &c., Marked with White Paint.
1376.70	1481.9	In Armstrong Co. Land of J. Scott, 1½ m. from Dayton.
1377.00	......	Line of Armstrong and Indiana Counties.
1378.35	1474.00	6′ right Chestnut Oak. On land of E D. Sheffer. In woods.
1401.20	1489.55	46′ right Cucumber Tree. Land of J. L. Buterbaugh.
1419.25	1463.35	8′ left White Oak, edge of woods. Land of Sam'l T. Fulton.
1429.15	1470.00	11′ right Apple Tree, in orchard, near dwelling of S. T. Fulton.
1442.90	1461.20	92′ right White Oak, near Public Road. Land of J. A. Wingrone.
1453.40	1433.50	170′ from Pin Oak. Smicksburg 2 miles north.
1481.90	1387.75	80′ right Wild Cherry. Land of Ephraim Ritchey.
1490.75	1403.00	6′ right White Oak. Land of Chris. Good.
1498.90	1305.00	35′ left Poplar. " " " *Smicksburg, about* 2 miles north.
1515.50	1278.10	15′ right spring house of Barnabas Lowe.
1519.00	1313.30	15′ left Apple. Land of Mrs. Lena Lukehart.
1537.00	1292.00	20′ left White Oak "snag." Land of Mrs. Catharine Bowser.
1544.80	1315.95	69′ right White Oak. Land of Mrs. Catharine Bowser.
1558.40	1464.50	90′ left dead tree. Land of John Lewis.
1559.90	1483.50	20′ left fence stake. " "
1561.30	1480.70	52′ right " " " Between two pines, on high hill, very prominent point.
1570.75	1309.30	9′ right fence stake, 150′ right dwelling of John Lewis.
1580.80	1338.50	8′ left fence stake. Land of Isaac Good. About 18 miles to Indiana and 20 miles to Kittanning from station 1580.80
1589.95	1279.30	4′ right dead tree. Land of Isaac Good.
1599.20	1350.10	19′ right dead Wild Cherry. Land of David Elkin.
1604.65	1300.30	37′ left dead tree. " "
1608.90	1246.60	4′ right White Oak. Edge Woods. Land of Jas. M. Wells.
1618.60	1256.50	6′ left Hickory. Edge Woods. Land of Jas. M. Wells.
1631.65	1225.80	107′ left Wild Cherry. Edge Woods. Land of Jas. M. Wells.
1638.30	1237.20	50′ right dead tree.
1642.80	1231.80	16′ left White Oak. Beginning of Woods.
1652.05	1225.45	12′ right " In Woods. Land of Robt. L. Mabon.
1665.50	1219.90	23′ left White Oak. Edge of Woods. Land of J. L. Mabon.

Stations.	Elevations.	Trees, &c., Marked with White Paint.
1669.60	1221.20	138′ left Hickory. Front of Mr. J. L. Mabon's dwelling.
1676.35	1228.45	35′ left White Oak.
1680.65	1279.60	78′ left Red Oak.
1684.20	1276.70	8′ left Maple.
1695.00	1899.30	right of gate post, near Absalom Neff's barn.
1701.45	1216.20	15′ left White Oak. Land of Absalom Neff.
1717.70	1245.90	9′ right White Oak. In Public Road. Land of John Smith.
1725.45	1314.00	28′ right fence stake, between house and barn of Mr. Smith.
1727.55	1313.50	32′ left Ash.
1739.00	1335.70	4′ right Cucumber Tree.
1745.20	1372.90	38′ right Ash. Land of Allen Hamilton.
1757.20	1344.35	73′ left Hickory. Land of Mrs. Hannah F. Hamilton.
1762.85	1303.60	right White Oak. *Smyrna Church* 900′ north.
1776.90	1326.15	15′ left Gum. Land of Silas W. Brady.
1781.50	1395.50	6′ left Pin Oak. In woods. Land of W. A. Hamilton.
1785.95	1321.20	2′ left fence stake. Land of Thomas Stuart.
1794.40	1316.40	21′ left White Oak.
1802.35	1513.60	7′ right Red Oak. Top Hill in woods.
1819.00	1294.40	55′ right large White Oak. Land of James Hopkins. Near Public Road.
1847.30	1428.40	6′ left fence, near dwelling of Moses T. Work.
1868.70	1277.80	15′ right White Oak. In Road. Land of E. I. Work.
1881.45	1341.30	20′ right Pin Oak. In Road. Land of Wm. I. Work.
1889.55	1354.10	70′ left Pine. " "
1898.40	1373.10	4′ right Pin Oak, in woods.
1910.90	1349.00	10′ left White Oak, edge woods. Land of Mr. Steffer.
1926.00	1350.10	8′ left " Land of Mr. Steffer.
1932.15	1271.40	6′ left White Oak. Land of Abner Griffith.
1934.40	1280.90	1′ left fence stake, in Public Road.
1950.50	1318.00	53′ right Locust. Land of Wm. G. Stewart.
1970.90	1347.80	4′ left Chestnut. Land of Samuel Lewis. In woods.
1984.90	1463.90	10′ left Chestnut. Land of J. J. Williams. Edge woods.
1991.70	1493.90	55′ right Chestnut, In field. *Marion*, ¾ mile south.
2002.60	1411.60	5′ right White Oak. In woods. " "
2014.35	1534.40	3′ left fence stake. In field. Land of Levi Spencer.
2018.75	1549.10	5′ left Chestnut. In woods. " "
2028.30	1486.90	14′ left White Oak. In clearing. Land of James Hunter.
2050.00	1666.70	8′ left dead tree in field. Land of James Hunter.
2057.10	1693.70	4′ right White Oak, in Public Road. Land of James Hunter.
2071.20	1627.20	11′ right dead tree. Land of Samuel Lewis. 15 miles to Indiana.
2079.85	1631.70	55′ right Hickory. Land of "Abe" Lowman, Jr.
2088.50	1594.30	3′ left Hickory. Land of Geo. Schrader.
2100.05	1457.80	8′ left Maple in Public Road.
2113.45	1471.50	5′ right dead White Oak. Land of Lorenz Reithmiller.
2118.40	1470.60	9′ right Wagon Shed, near Reithmiller's buildings.
2125.75	1413.00	4′ left dead White Oak.
2140.20	1643.90	3′ left Hickory. Beginning woods.

Stations.	Elevations.	Trees, &c., Marked with White Paint.
2153.50	1458.10	9′ right Lynn, in *new* Road. Land of Solomon Fullmer. In woods.
2155.15	1424.00	15′ right Beech.
2166.25	1398.70	4′ right Beech. In woods. Land of Kinter Heirs.
2167.00	......	In Public Road.
2167.95	1399.10	1′ right Maple. In woods. Land of Kinter Heirs.
2201.60	1588.10	11′ left Gum. In woods. Land of W. N. Barr.
2206.00	1647.80	1′ left dead tree. Out of woods.
2215.60	1591.00	34′ left Cucumber Tree. On land of Mrs. Eliza Rice. Mrs. Rice's buildings to the right.
2217.25	1587.00	In Public Road. 14 miles to Indiana.
2223.60	1643.80	1′ right small dead Chestnut, Beginning woods.
2233.95	1624.10	8′ right Maple. In woods.
2240.00	1527.80	13′ right White Oak. In woods. Land of Joseph Ober.
2242.35	1515.90	6′ left small White Oak.
2250.90	1620.60	16′ right "Snag."
2256.90	1640.10	7′ left Chestnut. In woods.
2262.00	1628.00	46′ left dead White Oak. Out woods.
2266.75	1586.20	50′ right Stump. Land of Moses and Wm. Lydick.
2278.20	1575.20	4′ left "Big" White Pine.
2284.90	1599.40	9′ left Poplar. Beginning of woods.
2297.15	1621.60	8′ left White Pine, in Public Road on land of Jacob Fyock.
2302.25	......	In cross roads. Dunkard Church close to the left.
2307.45	1643.90	15′ left White Oak. In Public Road.
2314.90	1665.10	11′ left Gum. " "
2333.75	1653.00	5′ right Chestnut. Land of Geo. Wise. In Public Road.
2338.55	1625.00	10′ left fence post. Solomon Wise's buildings to the right.
2354.00	1556.50	13′ left dead White Oak. Land of Mr. Mumma.
2363.75	1486.20	3′ right White Oak. Mrs. Catharine Barr's dwelling to the right.
2368.50	1446.50	11′ right Pine.
2382.50	1427.70	16′ right Apple Tree. Land of John Buterbaugh.
2393.80	1442.00	4′ right dead Pine. Mills and Dam to the right.
2405.30	1395.00	15′ left dead White Oak.
2417.50	1430.90	14′ left dead White Pine. Land of Mrs. J. H. Stumpf.
2430.35	1535.20	4′ left dead Pine in clearing. Land of Solomon Buterbaugh.
2433.45	1539.70	11′ right White Oak, near Public Road.
2450.45	1606.90	73′ left Pine "Snag."
2457.45	1584.80	56′ left large Maple. Land of Wm. H. Lutman.
2469.35	1581.30	16′ left White Pine. Back of Lutman's buildings.
2480.30	1576.40	4′ left Red Oak. On land of Mrs. McCullagh.
2481.75	......	In Public Road, near old Planing Mill. Cookport ⅓ mile to the south.
2487.30	1578.00	6′ right Chestnut, Land of Richard Cook.
2498.00	1555.30	1′ right Chestnut. In woods.
2515.85	1574.70	2′ right Pine, In Public Road.
2523.10	1559.60	4′ left Pine. " "
2536.50	1549.20	3′ left Pine. " " Land of Geo. Baker.
2553.50	1614.20	11′ right Stump. " "
2559.40	1604.70	16′ right fence " " Land of Peter Leasure.

Stations.	Eleva-tions.	Trees, &c., Marked with White Paint.
2561.75	......	Peter Leasure's buildings on both sides of road.
2562.85	1580.40	15′ left Balm of Gilead. Public Road.
2572.15	1574.80	12′ right Pine. " "
2584.60	1517.80	6′ right Hemlock. " "
2589.20	......	Compton's Saw Mill and Dam.
2592.30	1438.80	17′ right small Pine.
2595.45	1486.30	Right Red Oak, in woods.
2603.30	1570.50	4′ left Hemlock, "
2610.10	1512.20	6′ left " " In wood road.
2614.00	1467.90	9′ left " "
2621.95	1619.20	3′ left " "
2626.15	1638.40	20′ left Maple, near Public Road. Spruce P. O., ½ mile north. Cherry Tree 5½ miles north. Indiana 16½ miles south-west.
2628.25	1626.70	4′ right Hemlock. In woods.
2638.30	1527.00	3′ right White Oak. "
2640.15	1510.00	Two Lick Creek at Repine's old Saw Mill.
2642.95	1528.70	9′ right Maple. Land of J. C. Repine.
2655.15	1680.10	8′ right Stump. Land of Thomas Patterson.
2661.00	......	Public Road. Church to left.
2664.50	......	Patterson's buildings to left.
2666.34	1671.40	4′ right Chestnut.
2676.20	1736.20	7′ right Chestnut. Land of J. C. Leasure.
2683.45	1869.10	28′ left Chestnut. In road and in woods.
2691.50	1920.30	1′ right Chestnut Oak. In woods. Land of Thomas McDowell.
2701.05	1974.80	9′ left Chestnut Oak Land of Robert Pershing.
2705.20	1956.70	28′ right fence post.
2707.50	......	Pershing's buildings close to left.
2710.20	1946.60	4′ left fence stake.
2714.60	1972.20	5′ right Chestnut Oak.
2719.55	1963.30	1′ left fence stake in Public Road.
2722.90	1940.60	20′ right Hickory. Land of J T. Thomas, Sr.
2729.00	1906.00	17′ right Chestnut. Land of O. J. Williams.
2739.65	1965.30	5′ right Chestnut Oak. Land of David Martin.
2745.55	1999.20	8′ left Stump. *High point.* Divide between Alleghany and Susquehanna waters.
2751.00	1991.40	19′ right Stump.
2752.00	......	D. Martin's buildings to right.
2762.25	1970.80	6′ right Stump. In Public Road. Martin's store to right. 18 miles to Indiana. 16 miles to Ebensburg.
2770.80	1941.90	30′ right dead Pine. Land of J. Martin.
2774.25	1905.70	8′ right Hickory. Land of Mrs. Nancy Keith.
2779.70	1848.30	2′ left Beech. Beginning of woods.
2781.65	1843.90	4′ left Beech. Land of J. Martin. In woods. On waters of Dutch Run, flowing into the Black Lick.
2786.55	1830.20	4′ right Pine. *About* the line between Indiana and Cambria Counties.
2790.65	1825.30	4′ left Hemlock.

The whole of the stations are not given, as I thought it not necessary.

The stations "run" by hundreds of feet and the decimals of a hundred feet.—Station 2790.65 would read: two hundred and seventy-nine thousand and sixty-five feet; or, 52.85 miles.

Obituary Notice of JOHN C. CRESSON.

BY FREDERICK FRALEY.

(*Read before the American Philosophical Society, October* 19, 1877.)

John Chapman Cresson, late Senior Vice-President of the American Philosophical Society, was born in the City of Philadelphia, on the 16th day of March, A. D. 1806. He was the eldest son of Joseph Cresson and Mercy Chapman.

His paternal ancestor was Solomon Cresson, who came from France to America in the latter part of the 17th century. On the mother's side, he was descended from John Chapman, who came to Pennsylvania in 1684, among the first settlers of the Province, and who was one of the principal Surveyors for William Penn. On both sides the family were distinguished members of the Society of Friends, his grandfather, James Cresson, being an esteemed Minister. His grandfather, Dr. John Chapman, was a man of very eminent ability, by profession a Physician, and filled many public stations with honor and fidelity. He was a member of the State Legislature, and also of the House of Representatives of the United States. He was a member of the American Philosophical Society, having been elected February 12, 1768.

After receiving the usual elementary education in the primary schools, the subject of our notice was placed as a pupil in the Friend's Academy, then under the charge of Thomas Dugdale and Joseph Roberts. These were two of the best instructors of their day, and under their care he secured a thorough classical and mathematical education. He was very early distinguished by the accuracy, extent and diversity of his knowledge, and the training which he received under these eminent men in careful habits of study, and in becoming thoroughly acquainted with what he intended to learn, characterized the whole of his life and gave a remarkable tone to everything he did.

After receiving such an education, his first impulse was to study medicine, and he made the usual preliminary preparations for it that prevailed in those days, and for some months seemed to consider it as his future profession. But while he delighted in the study of its principles, he shrank from the labors and uncertainties of the practice of it, and after very valuable acquisitions in that noble science, he abandoned the study and determined to become an Agriculturist. He, however, cherished an ardent love for medicine, and the members of that profession, who were so fortunate as to enjoy his friendship in after life, have often spoken in high terms of the accuracy and extent of his medical knowledge.

About the time of making this change in his plans for a profession, he became acquainted with the late Wm. H. Keating, who had been recently elected Professor of Chemistry applied to Agriculture and the useful Arts, in a Department of the University of Pennsylvania, established by the Trustees, to meet what was then a matter of great necessity, and the results of which as we shall see hereafter were very important to the City of Philadelphia. In his attendance upon the lectures and other instruction of Professor Keating, he added greatly to his stock of knowledge, and he was therefore well fitted to begin the study of Agriculture.

He was placed under the charge of the late Isaac Price, of Chester County, and spent over a year in his family and under his instruction, becoming well grounded in all of the details of farming, and doing with his own hands every kind of farm labor. He subsequently entered the family of the late James Worth, of Bucks County, as pupil and friend, and with him completed his education as an Agriculturist. Shortly after attaining his majority, a farm in Cheltenham Township, Montgomery County, was purchased for him by his father, and he prepared to enter on the real business of life. In May, 1827, he married Miss Letitia L. Massey, daughter of Charles Massey, with whom he lived happily for almost fifty years. The issue of this marriage was one son and two daughters; the daughters died in early childhood. The son, Dr. Charles M. Cresson, is still living, and is an esteemed and useful member of our Society. Thus settled on his farm, and ardently attached to Agricultural pursuits, he went to work manfully to make his business a success. But in those days farming was far from profitable; produce of all kinds bore low prices, and with all his zeal and industry, and leading his hands in all work, the results gave no profit to represent even a moderate interest on the cost of the farm. After fighting fortune in this way for several years but without immediately abandoning his farm, he entered into partnership with two of his cousins and engaged with them in commercial business. The farm was sold in 1834 and he removed to Philadelphia, and from this time his real and useful history begins.

He became a member of the Franklin Institute in 1831, and there met a host of ardent men, the founders and builders up of that noble Institution. Prominent among these were Samuel V. Merrick, William H. Keating, Robert M. Patterson, Alexander Dallas Bache, Isaiah Lukens, Benjamin Reeves, Matthias W. Baldwin, Franklin Peale, George Washington Smith, John Wiegand, John F. Frazer, and others equally worthy, with whom he immediately became intimate in his friendship, and bound by a kinship of labor in the attainment and application of useful knowledge. Here he was in a congenial field, his old friend and preceptor, Keating, was in the forefront of the zealous workers of the Institute, and Mr. Cresson soon showed that while engaged actively in farming he had not neglected the text books of Philosophy and Science.

His knowledge of mechanics and chemistry was very comprehensive, and was immediately made available by placing him on committees charged with the investigation of mechanical and scientific subjects. We have not space to particularize all such labors, but when we say that for more than forty years he was an active member of the Institute, always ready for duty and always earnest in work, some estimate may be formed of this part of his career.

While thus, as it were, entering the threshold of his practical life, the corporate authorities of the City of Philadelphia, in 1835, determined to erect the Gas Works for the supply of the city. This work was carried out by Samuel V. Merrick, Esq., as Engineer, who had prepared himself for it by a visit to Europe, and a personal inspection of the Gas works in operation there. On the completion of the first section of the works and putting them in operation in 1836, Mr. Merrick desired to be relieved from the superintendence and care of the manufacture of Gas, and he was accordingly relieved. It then became an important question for the Trustees of the Works to decide as to whom the management of so important a business should be entrusted. After a patient inquiry and a scrutiny of the claims of other gentlemen, the place of Superintendent was tendered to Mr. Cresson, and being strongly urged by his friends Merrick, Keating, and Bache, to accept it, he yielded to their wishes. Mr. Merrick soon afterwards resigned as Engineer, and Mr. Cresson was then elected to that place as well as the one before held. He occupied these important and highly responsible positions for twenty-eight years, and the complete success of the Works in their manifold constructions, manufacturing processes, and the safety and extent of the distribution attest his marvelous skill and ingenuity. In the manufacturing department he was eminently successful, and the profits as well as the usefulness of the Works have become proverbial. While engrossed in such labors the Professorship of Mechanics and Natural Philosophy became vacant in the Franklin Institute, and in 1837, Mr. Cresson was unanimously chosen by the Managers to fill it. He accepted the appointment, and in this new field he soon took a high rank among the scientists of the day. His lectures were remarkable in the comprehensive clearness and simplicity of their style, and for the fullness and completeness of their illustrations, and his old students speak of them to this day in the highest terms of praise.

While he was holding this chair, the Controllers of the Public schools of Philadelphia determined to reorganize the City High School, and placed that work in the hands of Professor Alexander Dallas Bache. The plan adopted by him embraced a department of Mechanics and Natural Philosophy, and upon his recommendation Mr Cresson was elected to the Professorship. He held this office for about two years, discharging its duties with great fidelity and success, but the time taken was found to trench too much on his other engagements, and he resigned it, to the great regret of his associated professors and the students.

Mr. Cresson had by this time won a distinguished reputation in the scientific world, and in appreciation of it, the Trustees of the University of Pennsylvania conferred on him the honorary degree of Master of Arts.

A year or two later, he received from the University of Lewisburg, Pa., the honorary degree of Doctor of Philosophy.

In the year 1855, Samuel V. Merrick, Esq., the chief founder and second President of the Franklin Institute, resigned, and Mr. Cresson was elected almost by acclamation, to succeed him.

The establishment of the Franklin Institute in the year 1824, chiefly through the devotion and personal exertions of Messrs. Merrick and Keating, led to a more thorough appreciation of the dependence of the useful arts on the physical sciences. The Institute was soon a pronounced success. It brought together the best scientists of the City, and the great body of intelligent manufacturers, mechanicians, merchants, and professional men, and it thus entered on a career of usefulness which probably has not been excelled anywhere.

On coming to the City, Mr. Cresson entered actively in the work of this body and for upwards of forty years was an active participant in its labors and usefulness. As a member or chairman of important committees, as President, Professor and Counselor, he was always prepared and earnest. His usefulness was manifested in an eminent degree as Chairman of the Committee on Science, to which place he was elected on the resignation of Professor Bache, in 1844, and the reports and records of that Committee illustrate in their vast fields of inquiry, and the valuable results to inventors, the fertility of his own resources and the wisdom of his selection of the sub-committees charged with the duty of making investigations.

As a philanthropist, Mr. Cresson was equally distinguished. He was for many years a Manager and one of the Vice-Presidents of the Pennsylvania Institution for the Instruction of the Blind, one of the Managers of the Episcopal Hospital, and of the Western Saving Fund Society, and a member of, and contributor to, other charitable institutions. But his services in these respects were specially made available for the Institution for the Blind, for the Saving Fund Society, and for the Episcopal Hospital, his connection with them terminating only at his death, and the management of these great charities expressed their sorrow for his loss, in resolutions that truly declared his merits and services.

In the year 1852, he was elected a Trustee of the University of Pennsylvania, which office he also held at the time of his decease.

In this body he was distinguished, as in all other places, by devotion to the best interests of the institution, heartily, co-operating and sometimes leading in the great improvements that have been made in the methods and extent of the instruction given to the students.

Mr. Cresson served for several years as a Manager of the Schuylkill Navigation Company, while its affairs were under the Presidencies of Solomon W. Roberts, Esq., and Charles Ellet, Jr., Esq., and he gave useful aid in preparing plans and carrying out the great enlargements of the canals and other works of that Company during the years 1845 and 1846.

He was elected President of the Mine Hill and Schuylkill Haven Railroad Company, in the year 1847, which office he held until his death. Under his administration of the affairs of this Company, its trackage and equipments were largely increased, and it became the principal carrier to the canal and railroad trunk lines of the Anthracite Coal trade of Schuylkill and Northumberland Counties.

He was appointed one of the original Commissioners of Fairmount Park, and was a prominent participant in perfecting the organization of that body, and in adopting its preliminary plans for the extension and arrangement of the Park. Having at this time been relieved from some of his other appointments and duties, he found in the work of the Park a renewal of his old affection for rural occupation, and he cheerfully yielded to the call of the Park Commission to become their Chief Engineer. He entered on this field of duty with a zeal and fidelity that soon manifested his power and genius.

His plans for the improvement of the Park were simple but comprehensive. He seized upon the natural features of the land and the presence of its ancient forest trees to lay out roads and pathways, that should traverse attractive and beautiful spaces and present to the eyes of the visitors resting places of a graceful and attractive character.

To him the arrangement and embellishment of the Park was a labor of love, and he still worked for it when unable to leave his house and bed, while suffering from acute disease.

He had the wide area of the Park mapped, as it were, upon his brain, and his directions to his assistants for the prosecution of their work were as clearly given as if he were standing by them in the field. But he yielded at last to the necessity of parting from a work calling for such continual mental labor, and he resigned at the close of the year 1875.

In the year 1839, he was elected a member of the American Philosophical Society, and the proceedings contain many evidences of his success as an original investigator and careful student of science.

He was elected one of its Vice-Presidents in 1857, and by continued re-elections he became the Senior Vice-President, and held that office when death terminated his membership with us.

He visited Europe once on professional business, and twice for medical advice, and during these visits became acquainted with the prominent scientists of

Great Britain and France, and he often spoke of the heartiness with which he had been received by them, and of the special benefits he had derived from his intercourse with them;

We have now briefly sketched the active life and labors of Mr. Cresson, and the results which they brought to him in the way of reputation and honors.

It remains to us now to endeavor to portray him as a man, and to show that with the endowment he had of such goodly gifts, he was equally blest with moral and social virtues, and with physical strength and beauty.

Mr. Cresson had a stature of over six feet in height, his frame was in harmony with it in being large and well-proportioned. His head, although not large, was admirably formed, and his countenance was mild and beautiful, lighted up with eyes brilliant and expressive.

His manners were easy and dignified, receiving every one with affability, kindness and courtesy, but never permitting undue familiarity. He possessed great conversational powers, and his extensive reading and knowledge gave him the command of a vast variety of subjects, which enabled him to become an acceptable associate of old and young, learned or unlearned, and to give exquisite pleasure to all brought into personal contact with him.

He always had strong religious convictions, and his early training, as a born member of the Society of Friends, undoubtedly gave him his robust morality.

He lost his membership in that Society by his marriage with a lady who was not a member, and while he always remained on terms of great intimacy and friendship with his old friends of the good Quaker faith, his mind was awakened to religious principles of a more definite and outwardly expressed form, and he became by baptism and confirmation a full member of the Episcopal Church. In this membership, as in everything else he did, he was ardent, consistent and useful, freely giving of his labor and substance in aid of Church-work, and by personal example giving force and beauty to his Christian life. In his family he was the affectionate and dearly loved son and brother, the kind, indulgent and devoted husband and father, entwined around every heart with the strongest bonds.

He was a man of great moral and physical courage, never fearing to call a fault or a crime by its right name, and never hesitating by personal interposition to endeavor to check or subdue a wrong doer whom he found engaged in work threatening the peace or security of private citizens or of the public. Sustained by these well-balanced virtues, and by his sincere religious principles, and his thorough trust in the goodness and wisdom of God, he went through a life of nearly seventy years, always cheerful, happy and useful, and looking forward to the close with faith and hope quite equal to those of the patriarchs of old.

In his early manhood he had two very severe attacks of illness, both of which brought him to the verge of the grave, but even then his meek and quiet spirit and his strong trust greatly aided his physicians, and he seemed to be providentially raised for his future work. During the holding of the great Sanitary Fair in Philadelphia, in the year 1864, in the preparation for which and in its management and success, he had borne a great share, the first symptoms of the disease which terminated his life made their appearance.

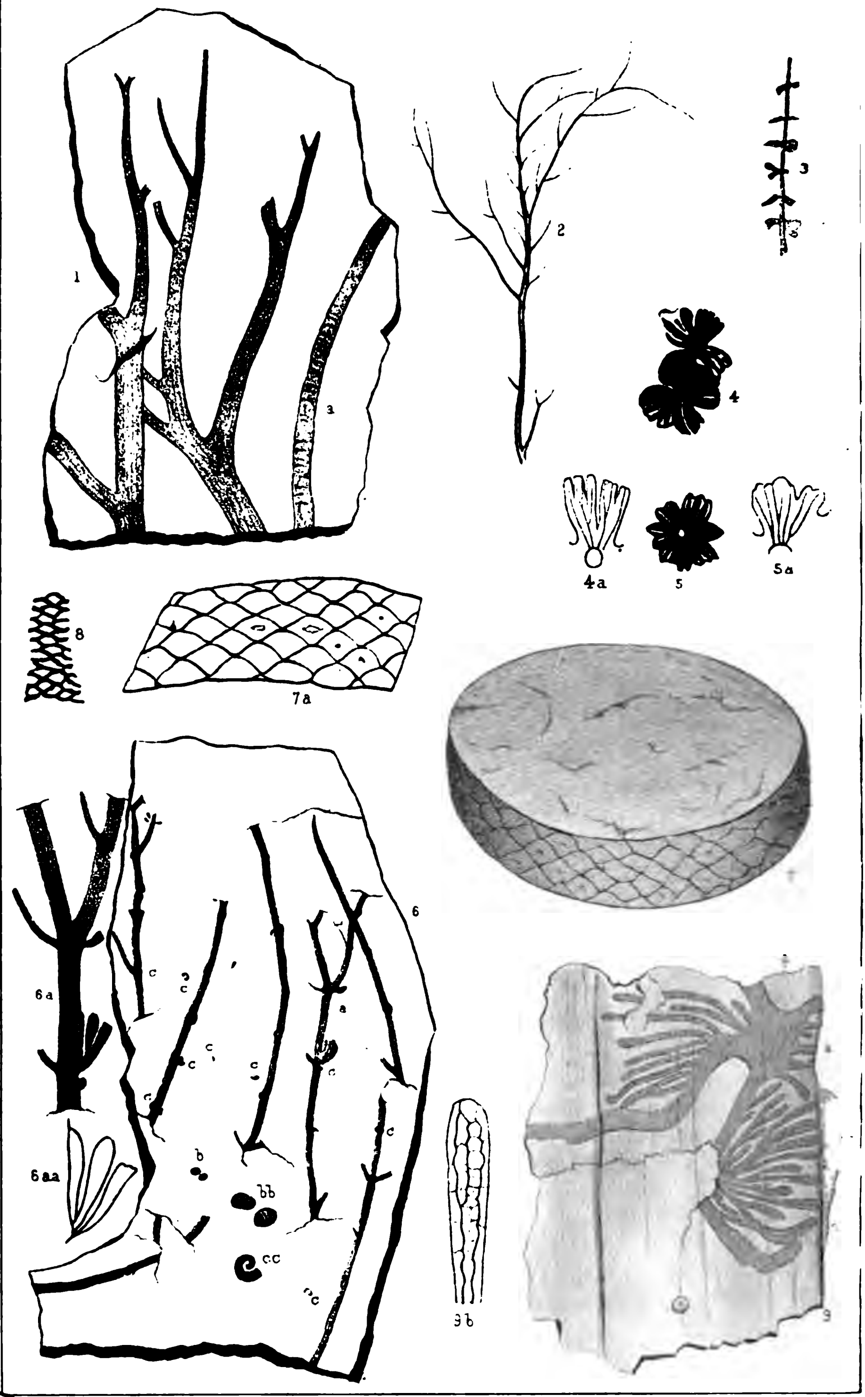
He, however, speedily recovered from the violence of the first attack, but the disease assumed a chronic form, and went on, year by year, in spite of usual remedies, increasing in its activity, and gradually leading to that prostration which, in 1872, took him to Europe to seek special advice. He returned much invigorated by the treatment and voyage, but in a few months the unfavorable and violent symptoms again returned, and he made a second visit. On this occasion he submitted to several operations of lithotrity, and embarked for home in the hope that he was permanently relieved. He, however, had a painful voyage, and after he reached home he gradually became more and more impaired in health, and was finally confined to his chamber and couch. Here for many months he suffered the most intense pain, which could only be made bearable by the strongest opiates, but in the short intervals of ease he was the same cheerful and ready friend, pouring out the vast stores of his knowledge, philosophizing on the pleasures of nature, the mysteries of life and death, and looking forward with hope, patience and faith, to the time when all pain and suffering would cease, and his reward for it all would be found in the peace and rest of Heaven.. It was during these years of trial and suffering that all the beauties and harmonies of his character shone with marvelous effect. His friends left his chamber greatly wondering what manner of man he was who could bear so much without repining, and they went forth thankful for such an example, and greatly strengthened by it for their own application.

He sank quietly to rest as the sun was setting, on the 27th day of January, 1876, in the 70th year of his age, taking his departure with his eyes resting on the old forest trees of the Woodlands, then stript of foliage and taking their winter rest, but with the consciousness on his part that the coming Spring would awaken them to a resurrection of beauty, and that he also in due time would rise again in a spiritual body, and be made one with his Master, Christ, in glory.

For more than sixty years he was my associate friend and brother. His life was part of my life, we lived and labored together in the same fields, partook of the same cares and trials, and while I pay this loving tribute to his memory I feel that I but speak for all when I say

> "None knew him but to love him,
> None named him but to praise."

Proc Amer. Phil Soc. Vol XVII. No 100 p.163. Plate IV



Sinclair & Son, Lith.

Silurian Land Plants. Fig. 9 9b. Carboniferous fungus.

UNIV. OF MICH.

Land Plants, recently discovered in the Silurian Rocks of the United States.

By Leo Lesquereux.

(*Read before the American Philosophical Society, October* 19, 1877.)

The first remains of land plants known from the lower Silurian, were found some years ago by Dr. S. S. Scoville in blue, hard, sandy clay, or marly shale, of the Cincinnati group, on Longstreet Creek, six miles east of Lebanon, Ohio.

This discovery, an important one for the Natural History of this country, was recorded in the Am. Journ. of Sciences and Arts, Jan. 1874, p. 31, and the remains, representing two fragments of stems or branches, were briefly described at the same time. Their reference to the botanical group of the *Sigillariæ*, was then hypothetically admitted, from the likeness of the scars of the surface of one of the fragments to species of this genus: *S. Brardei*, *S. Menardi*, etc.

Later, Prof. Newberry, to whom the same specimens were communicated also, gave an acconnt of them with figures in the same Journal, Aug. 1874, p. 110, considering them, in the conclusion of his remarks, as casts of some large *Fucoids* or marine plants. As the doubt could not be cleared up by mere discussion, the subject was dropped, in the hope that the discovery of other materials of the same kind might afford more light upon the true character of these vegetable remains.

In the meanwhile, as the specimens of Dr. Scoville had been returned to me, I made a new and more attentive study of them, had them carefully figured, and the characters given in the original description being recognized as exact, all the documents, specimens and drawings were, at the request of Prof. J. D. Dana, sent to him for examination, and also referred by himself to Profs. D. C. Eaton and A. E. Verrill of New Haven. These celebrated Naturalists, the more competent judges on the subject, recognized the fragments as positively referable to land plants by their characters.

Other specimens still more evidently representative remains of land vegetation were soon after communicated from the Silurian of Cincinnati, and also from the lower Helderberg Sandstone of Michigan; and as still more of the same kind had been promised, the publication of the descriptions was postponed, in order to have, for indisputable evidence, a sufficient number of these vegetable fragments, from which also the relative characters of this new flora might be discerned.

Just now a branch of a fern has been obtained from the Silurian Schists or Slates of Angers, France, and the fact is reported to the Academy of Science of Paris, by Count Saporta, with the remark, that this important discovery was forestalled in America, where remains of Silurian Land Plants had been found whose description would be greatly desirable at the present time.

We have thus a sufficient reason for the publication of the following documents relative to the subject.

DESCRIPTION OF SPECIES.

Genus PSILOPHYTUM, Daws.

Quat. Journ. of the Geol. Soc. of London, p. 478.

"Lycopodiaceous plants, branching dichotomously and covered with interrupted ridges or closely appressed minute leaves; the stems, springing from a rhizome, having circular areoles sending forth cylindrical rootlets. Internal structure, an axis of scalariform vessels, surrounded by a cylinder of parenchymatose cells and by an outer cortical cylinder of elongated woody cells (prosenchyma). Fructification probably in lateral masses protected by leafy bracts."

The species which I have to describe here differs by these points only from the generic description: the stems of one of them has not any interrupted ridges or striæ of any kind; both are without leaves. But in the species described by the author the leaves are either rudimentary or, more generally, the stems are naked, either in their original growth or by denudation, caused by maceration or other physical circumstances. For example, *Psilophytum elegans* and *P. glabrum* have no leaves; *P. robustius*, judging from figure 121 in Dawson's *Precarboniferous plants* of the Geological Survey of Canada, bears leaves at the extremity of the branches only, and the stems appear smooth as they are also in *P. glabrum*.

PSILOPHYTUM GRACILLIMUM, sp. nov.

Pl. I, fig. 2.

Stem very slender, dichotomously branching, smooth or naked half round, slightly channeled in the length; branches numerous, of various length, filiform.

The stem is scarcely one millimeter thick at the base; the upper branches, curved as from a spiral unfolding, are slender, gradually attenuated and capilliform, or of the thickness of thin thread at their extremities.

The plant embedded in hardened, blue, shaly clay or marl, is transformed into coal, part of the branches broken and displaced having left their prints as half cylindrical concave moulds. This character, as also the depression in the middle and along the whole axis, proves the woody or vascular texture of the plants and of course separates them from the *Fucoids*.

Comparing this specimen with species published by Prof. Dawson from the Devonian measures of Canada, its relation to *P. elegans*, Quat. Journ. Geol. Soc., Nov. 1862, p. 315 Pl. xiv, fig 29, 30, is recognized as quite close. But the affinity of the characters is still more marked with a plant of *Psilophytum* as restored in its original state for exemplification of the genus in the Proceedings of the same Journal, Jan. 1859, p. 479, fig. i. If this figure, whose stem is without leaves, was the exact representative of a peculiar species I should have considered our silurian form as identical with that of Canada.

The specimen from Cincinnati, a piece of shale, one or two centimeters thick, has on the reverse fragmentary remains of the same plant, especially some upper branchlets like fig. 2*a*, more evidently hooked than those of the main stem. Both the upper and lower surface of the shale are smooth, have no animal remains; but the intermediate layers hold small molluscan species characteristic of the Cincinnati Group.

Habitat. Near Covington, opposite Cincinnati, in the bed of the Licking River. Found by Mr. Ed. Ulrich; communicated by Rev. H. Herzer.

PSILOPHYTUM CORNUTUM, sp. nov.

Pl. I, fig. 1.

Stem thick, dichotomous; divisions variable in distance, the terminal ones short, pointed, nearly equal in size and length; surface slightly rugose and irregularly striate.

The branches in the lower part are thick comparatively to their length, three to four millimetres, irregularly striate when decorticated, or merely punctate upon the thin bark, with small projecting dots resembling the basilar remains of scales or small decayed leaves; lateral branches short, narrowed to a sharp point; the upper or terminal ones about equal in length, appearing like a pair of small pointed horns.

The species is comparable only to some of the fragments not specified but figured by Prof. J. W. Dawson (Geol. Survey of Canada, Fossil Plants of the Devonian and Upper Silurian formations, figs. 243, 244). The author remarks, "that these fragments are probably originating in the Upper Silurian of Gaspé; that as they are found in the lower part of the Limestone which underlies the Devonian Gaspé Sandstone and become more abundant in the upper beds, this suffices to indicate the existence of neighboring land, probably composed of the Silurian rocks, and supporting vegetation."

From the preservation of its branches even to the smallest subdivisions, the specimens here represent part of a plant embedded in the place of its growth. The matrice is a piece of very hard calcareous shale, seven to eight millimetres thick, bearing on one side irregular undulations like ripple marks, without any trace of organic remains, and on the other the fragments of plants as figured here. The branch in *a* represents a different species, and indeed a marine or rather a brackish plant, closely related to species of the present genus *Chorda*, Stack. This fragment seems to have been mixed in the tide pools with freshwater or land plants growing there. For, another thick specimen of the same locality, and compound, bears a profusion of marine mollusks, and has only branches of this as yet undescribed marine species: *Calamophycus septus*, whose character may as well be here fixed.*

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* Genus CALAMOPHYCUS.

Same characters as the species.

CALAMOPHYCUS SEPTUS, sp. nov.

Fronds simple, cylindrical, elongated, gradually tapering to a point;

Habitat. Lower Heldeberg Sandstone, Michigan. Discovered and communicated by Dr. Carl Rominger, State Geologist.

CALAMARIÆ.

ANNULARIA ? Brgt.

Stem articulate ; leaves virticillate, lingulate, gradually narrowing to the base, either pointed or rounded at the top ; midrib thick.

Our species differs from the generic characters by the absence of a midrib. The leaves, however, are very small, indistinct, their substance being amalgamated into that of the stone, and the nervation is nearly obsolete.

This vegetable form might be referable to *Sphenophyllum*, or even to some peculiar generic division. Its characters relate it positively to the sections of the Calamariæ, as far as it is fixed until now.

ANNULARIA ROMINGERI, sp. nov.

Pl. I, fig. 6.

Stems long and slender, articulate, smooth ; articulations at regular short distances, inflated, bearing oblique branches and leaves ; leaves small, lingulate, apparently flat, either truncate or rounded at the top ; nervation obsolete.

The inflated nodi and the flattened leaves, refer the plants to *Sphenophyllum*, while the obtuse, entire, numerous leaflets, disjointed to the base, relate it to *Annularia*. From both these genera it is removed by the smooth, not ribbed, nor striate stem, and by the oblique direction of the branches. By this last character it is allied to *Asterophyllites*. The articulations are numerous, five to eight millimeters distant ; the leaves scarcely three millimeters long. The direction of the branches, all in the same way and nearly parallel, shows that they were attached as branches to the same stem, and not displaced by water or by any kind of transportation. Like the fragments of fig. 1, they have been embedded at their place of original growth. This fact is rendered still more evident by the presence of small Serpulids (fig. 6*c*, enlarged *cc*), a considerable number of which are attached to the stems and strewed over the stone.

The specimen bears also (fig. 6*b*,) oval granulate protophytes : *Xanthidia ?* seen enlarged in *bb*.

Habitat. Same as the former species in the lower Helderberg sandstone formations of Michigan. The compounds of the specimens are still harder and more calcareous. Found like the former, and communicated by Dr. Carl Rominger.

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cavity divided by transverse membranes, either passing through the whole diameter, or connected in the middle to vertical subdivisions.

The internal parieties, irregular in distance and thickness, are distinctly seen through the smooth epidermis, which, moreover, is often destroyed, the internal structure being thus clearly exposed. The cavity of the stem is inhabited by the same species of *Serpulid* as seen in fig. 6 *c*.

SPHENOPHYLLUM, Brgt.

Stem articulate, leaves verticillate, cuneiform, crenulate, dentate, or lobed at the upper part which is truncate or rounded; midrib none; nerves straight, diverging fan like, simple at the base, dichotomously forking once or twice.

Here also, the vegetable fragments, which we refer, legitimately it seems, to this genus, differ in one point from the typical characters established from Carboniferous specimens. In these, the leaflet, generally four to six, are separated to the very base or free. In the Silurian plants, the whorls or leaflets, four or five, compose a single leaf, the divisions being lobes, cut indeed to near the point of attachment to the stem, where they are joined in obtuse sinuses. The character is distinctly seen upon the specimen fig. 4 and 5, enlarged in 4 ᵃ and 5 ᵃ. None of the authors describing this genus, since it was fixed by Brongniart, has remarked upon the connection of the leaflets at their base, though this connection is often represented by the figures given of species of *Sphenophyllum*, as for example, *S. oblongifolium*, Germ. and Kaulf. in Geinitz, Verst. v. Sachsen, pl. xx, fig. 12, where a whorl is represented with six leaflets free from the stem, whose place is marked by a circular round central scar, the leaflets being united at their base as by a ring. I must say also, that in the very numerous specimens of *Sphenophyllum* which I have had for examination, I have very often remarked this connection of the leaflets, but never, however, as distinct and as distant from the base as in the following species. In *S. Schlotheimii* and *S. oblongifolium*, the nerves are positively simple at the base, though two or more in the same leaflet. This character of course implies a connection of the border of the leaflets at or near the base, and in this case, they do not leave distinct impressions of their point of attachment to the stems. I therefore admit the Silurian plants as truly referable to this genus, the difference remarked in its characters being merely specific and apparently proper to a type not yet fully developed.

SPHENOPHYLLUM PRIMÆVUM, Lesqx.

Pl. I, figs. 3–5.

Stems or branches slender, articulations close, equidistant; leaves in whorls of four or five leaflets connected towards the base and joined by slightly obtuse sinuses; leaflets either truncate and crenulate at the top, or sometimes deeply split or lobate; nerves simple at the base, sparingly dichotomous, forking mostly once, even simple.

If we would not take into account the connection of the leaflets, the relation of this species to *S. Schlotheimii*, Brgt., and especially to *S. oblongifolium*, Germ., as figured by Geinitz (loc. cit.), would appear very close. The difference would be marked merely by the shorter leaflets or the smaller size of the plant and the less enlarged divisions. In the Carboniferous species, which is also frequently found in the American coal measures, the veins, simple at the base, and generally two for each leaflet, have also few divisions, forking only once or twice.

The specimen of fig. 3, have the stems distinct, slightly striate, even slightly inflated at the articulations, a character observable only with a strong glass. Fig. 4 has also the stem distinctly seen between the two whorls, and even fig. 5 has, dimly seen, a remnant of stem as represented upon the figure.

There is a difference in the size and the subdivision of the leaflets of fig. 3; but the woody matter of the plants softened by decomposition has penetrated the clay where the vegetable fragments are imbedded and the outlines of the leaflets are indistinct. On one of them only the nerves are perceivable. The identity of the species represented by fig. 3, with those of figs. 4 and 5, is not ascertainable, but they all evidently represent the same Genus.

There is in the Museum of Comparative Zoölogy of Cambridge a piece of true *granite* bearing remains of a fine branch of *Sphenophyllum;* three whorls of leaves, whose stem is destroyed by decomposition, but whose outline and nervation are perfectly and very distinctly preserved. The positions of the whorls is half quincuncial, two of them placed at the base and one between them at a distance above; the centres of the leaflets representing the three points of an equilateral triangle.

The leaves doubly larger than those of our fig. 5, measuring two centimeters in diameter, are divided into five lobes, distinct to a distance from the round central point of attachment to the stem; truncate and crenate at the top; with each three to five nerves; simple at the base and forking only once in the middle or near the point. The divisions of the border are irregular as in our figure, which it represents exactly in just double size.

We have been more than once discussing with Prof. Agassiz the origin of this remarkable vegetable fragment. Now that congeners are recognized in the Lower Silurian its presence upon granite is explainable, perhaps, as resulting from the casual deposit of a branch of *Sphenophyllum* thrown out into a basin of fresh water, upon granite rocks bordering swamps. Or possibly, the plant grown in place has been preserved by the drying and hardening of a film of decomposed vegetable matter, which seem to adhere to the surface of the granite, As the vegetation of the carboniferous is known by remains of materials heaped in place for a long period of time, and preserved into the compounds formed by deposits of the same age, the mode of preservation of this plant upon granite, is therefore different. Hence the reference to the Silurian of this branch of *Sphenophyllum* is merely authorized by the identity of its character with those of the species described from the Cincinnati group.

Habitat. Covington, opposite Cincinnati, specimen fig. 3, discovered by M. E. I. Ulrich. The fragments communicated by Rev. H. Herzer are in fine grained blue clay or marl, a compound like that where *Psilophitum gracillimum* is embedded. Specimen fig. 4 was sent by Mr. Mickleborough, School Principal, and found by him in the corporate limits of Cincinnati, in a locality known as Limekiln Run, about three hundred and seventy feet above low water of the river. That of fig.

5 was communicated by Mr. C. B. Dyer. It is upon the surface of a stone exposed for a long time to atmospheric influence. All the specimens are from around Cincinnati, in connection with invertebrate animal fossils of the Cincinnati Group.

Plants of the same kind have been found many times already it seems; for Professor Mickleborough informs me that another specimen discovered within the clay, somewhat obscure, and apparently like the one of our fig. 3, was washed and rubbed in order to expose the leaflets more distinctly, and in that way the leaves were nearly totally effaced. Another offered for sale was from description like that of fig. 5. Still others have been mentioned to me. They have been considered by some collectors as the work of insects; by others as fucoidal or coralline productions, like *Oldhamia;* and by others as specimens of the vegetation of the Carboniferous transported by drift. All these suppositions are contradicted by the fragments found imbedded in the clay or attached to pieces of hardened clay of the same compound as the Cincinnati blue marl, and still more by the described characters of these plants.

PROTOSTIGMA, Lesqx.

This Generic name is provisionally admitted for the description of fragments of stems whose relation to species of *Sigillaria* and other types of vegetables of the Devonian and the Carboniferous is surmised from the rhomboidal form of the scars or bolsters marked upon their bark. This form is very commonly seen upon plants of this kind. It characterizes in its multiple more or less definite transformations, the impressions of the outlines of the points of attachments of simple leaves to stems, branches or trunks of trees of the old formations. Therefore, it would not be surprising to find it already traced upon Silurian woody stems or branches. The reference of those original marks, as long as they are not defined by the vascular scars in the middle, is not possible This is implied by the name under which the remains are described.

PROTOSTIGMA SIGILLARIOIDES, sp. nov.

Pl. I. fig. 7–8.

Branches or stems cylindrical, scarcely flattened by compression; surface marked by rhomboidal cicatrices, enlarged on the sides, contiguous and in spiral order, with indistinct impressions of oval vascular scars in the middle.

I refer to this specific form three specimens, two of which are figured here. The fragment of branch, fig. 7, is represented in its natural size. It is slightly obliquely compressed, and thus, the lateral bolsters are somewhat disfigured on the two sides, and displaced from their normal position. But on the face as seen in fig. 7 and 7 a, the scars are preserved in their original arrangement. Even the central vascular points are distinctly seen in the middle of some of the bolsters, though the whole impression is of course somewhat obliterated by erosion of the mould, or by decomposition of the vegetable fragments embedded into the clay. Another specimen not figured is larger, seven centimeters in diameter, nine centimeters long, nearly exactly cylindrical, with irregular more or less distinct ribs, marked crosswise by large wrinkles or irregular protuberances, which do not show any distinct relation of form and position between them. Therefore, both these fragments are identified merely by their cylindrical shape, representing stems or branches, and by their common habitat. The compound of both is exactly of the same matter, a hard bluish clay or marl mixed with grains of coarse sand. This compound has taken the place of the woody matter destroyed by maceration, and therefore nothing is left of the original vegetable fragment but the outline of the stems and the impression of the scars of the bark.

The fact of the total disappearance of woody fibres in fossil specimens cannot afford an argument against their reference to land plants ; for even in the coal measures, trunks of *Sigillaria*, *Lepidodendron*, etc., are very often recognized in sandstone merely by cylindrical outlines of the trunks, and impressions of the scars of the surface of the bark. This mode of petrification is general for isolated fragments of wood.

As related to the same kind of vegetable we have a fragment, fig. 8, found near Cincinnati, in strata of the Cincinnati group, and which confirms the reference of the specimens discovered by Dr. Scoville both to the locality named, Longstreet Creek, and also to the formation of the Cincinnati group. This specimen at the same time represents more evidently the *Sigillarioid* character by its rhomboidal form, the cicatrices and their position in spiral being still more distinctly seen than in fig. 7, though the piece of bark whose impression is so well preserved has been apparently flattened by compression. No trace of vascular scars is remarked however. These scars are generally erased in specimens whose surface bark has been decomposed and destroyed.

As remarked above, cicatrices of the same character, often without central points, are seen on the surface of the bark of *Artisia*, *Leptophleum rhombicum*, *Sigillaria Brardii*. *S. Defrancii*, and other species of the coal.

I have a remarkably fine branch of an *Ulodendron* from the Cannel coal of Pennsylvania, which bears outside cicatrices exactly like those of fig. 7, with oval central vascular scars. The size of this branch is about the same, for it measures twenty centimeters in length, and is only twenty two millimeters broad, though slightly flattened. Its impression into cannel coal is perfectly distinct. Hence the objection against the reference of the specimens of the Silurian to land plant on account of their small size is groundless.

On the reign of organized beings to which these fragments are referable there can be therefore no doubt, for considering merely the size of the stems and their cylindrical form they evidently represent plants.

The question is therefore on the relation of the stems to land or marine plants. Besides the authorities which have been quoted as regarding as evident the relation of these fossil remains to land plants, the analogy of the characters described and their comparison to those of some vegetable of the coal is evidence of their nature. And though these remains have been found in old formations, wherefrom as yet no trace of land plants had been obtained, the doubt on that score is now removed by the discovery of other plants of the same kind in the Lower Silurian of North America, and still more by that of a Fern in the Lower Silurian of France, the schists of Angers, which seem to be related by synchronism to the Cincinnati Group.*

On the character of this American formation, T. A. Miller remarks, in his Catalogue of American Paleozoic fossils, "that in the Western States of North America, where the Utica Slate is absent from the Hudson River Group, the upper part of the Lower Silurian is generally called the Cincinnati Group. Its strata exposed in Ohio, Indiana and Kentucky, do not exceed one thousand feet in thickness. The lower part is probably the equivalent of the upper part of the Trenton Group. The remainder belongs to the Hudson River Group. The total thickness of its exposure scarcely exceeds one thousand feet.

Some of its characteristic fossils as *Bellerophon bilobatus, Strophomena alternata, Zygospira modesta, Leptena sericea, Buthotrephis gracilis, Beyrichia chambersi, Calymene senaria, Isotelus gigas* and *I. megistos*, pass entirely through the Group. *Trinucleus concentricus, Triarthrus becki, Orthis multisecta, O. emacerata, Streptorhynchus hallia, Ambonychia bellistriata, Modiolopsis cincinnatiensis, Cycloconcha mediocardinalis, Lichenocrinus crateriformus*, and *Chetetes* (?) *jamesi*, are confined to the lower half of the group. *Glyptocrinus decadactylus, G. dyeri, G. nealli, G. fornshelli, Lichenocrinus tuberculatus, Streptorhynchus filitexta, S. subtenta, S. sulcata, S. sinuata, S. nutans, Orthis insculpta, O. subquadrata, Rhynchonella capax, R. dentata, Cypricardites haynesi, Anomalodonta gigantea, A. alata, Anodontopsis milleri, Favistella stellata, Tetradium fibratum*, and *Streptelasma corniculum*, are found only in the upper part of the group. Some fossils occupy only a few feet in vertical range, as *Orthis insculpta, Orthis retrorsa, O. emacerata, Glyptocrinus nealli*, and *Streptorhynchus sulcata*.

This formation is composed in its whole of alternate layers of blue marl and limestone of variable thickness, the limestone layers rarely attaining one foot.

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* Since the preparation of this paper, I have received from Rev. H. Hertzer, 15th Oct., 1877, three small specimens distinctly related to the fragments described above by the characters and disposition of the cicatrices of the surface, but greatly different by the form of the bodies. One of them is comparable to our figure 8. It is a little larger, convex on the surface, and seems part of a branch. The two others, both of the same size, resemble gibbous tubercles, or rather small door knobs, four to five centimeters in diameter, with border rounded and the upper surface flat or slightly convex. One of them has in the middle a scar-like depression re-

The schists of *Calymene Tristani*, where the fern mentioned above was recently discovered, have been considered by Dufrenoy as an upper member of the Caradoc sandstone of Great Britain. The Cincinnati Group is generally referred to this formation. Its relation, however, to the schists of Angers is not positively fixed. The preponderance of species of *Calymene* like *C. senaria*; of analogous Genera, *Triarthrus becki*, etc., so common in the blue shale of the Cincinnati epoch, seem to indicate a close relation between both formations of Europe and of America. The enumeration of fossils considered characteristic of the Cincinnati group may afford by comparison more positive evidence of the geological relation of the strata where the first Silurian remains of land plants have been found.

It is a remarkable fact that the character of these Silurian plants, described above, give us like a microcosmical representation of the flora of the Carboniferous, so simple and at the same time so admirable in the multiple subdivisions of its specific forms. The coal flora is a compound mostly of vascular cryptogamous plants: Lycopodiaceæ, Ferns and Equisetaceæ, and of some Phænogamous Gymnosperms whose types are apparently related to the Cycadeæ or to the conifers.

We now have represented in the Silurian,

1st. The *Lycopodiaceæ*, by species of *Psilophitum;* diminutive forms but primitive types of the *Lepidodendræ*, represented in the coal by very large trees distributed in a number of generic and specific divisions.

2d. The Ferns, by a species related to *Paleopteris* or to the group of the *Neuropteridæ* which makes the finest and most common species of the coal. The fern of the schists of Angers is named *Eopteris Andegaversis* by Saporta, who discovered it.

3d. The *Calamariæ*, by *Sphenophyllum* and *Annularia;* these forming two sections related to the *Equisetaceæ*, but whose vegetable affinity is not satisfactorily ascertained. They represent Cryptogamous acrogens like the ferns.

6th. The *Sigillariæ*, placed by some authors as an order of plants between the Conifers and the Cycadeæ, or representatives of the Phænogamous gymnosperm. We have, it seems, a species of this group in the *Protostigma*.

The *Cordaites* now are considered Conifers.

From the preponderance of large fossil trunks of Conifers in the Devo-

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sembling the point of attachment of a tuft of leaves. Both are marked around on the borders and upon the top surface by rhomboidal cicatrices in spiral order like those of our figure 7. Some of these especially along the border are deep and have very distinct central mammillæ like points of vascular scars. These organized bodies are attached to broken pieces of Silurian limestone, bearing upon the lower part fragments of small marine mollusks. This, together with their shape, their convex or flattened surface, seems to prevent their reference to *Sigillarioid* plants. They look however like miniature trunks of *Cycadeæ*, which for many of their species nian one may expect to find remains of the Pine family in older formations. When therefore we get from the Silurians fragments of leaves of *Cordaites* (a probable discovery, for they have been found abundant in the Devonian) we shall have all the essential types of the plants of the Carboniferous flora already represented in the oldest paleozoic times.

A Species of Fungus recently discovered in the shales of the Darlington Coal Bed (Lower Productive Coal Measures, Alleghany River Series) at Cannelton, in Beaver County, Pennsylvania.

By Leo Lesquereux.

(*Read before the American Philosophical Society, October* 19, 1877.)

The discovery of a *Fungus* in connection with plants of the coal measures is not less remarkable than that of land plants in the Silurian.

Lindley and Hutton, in their Fossil Flora of England, 1831-33, have represented (plate 65 of the first volume) a kidney shaped, round, flattened body, whose outline and surface, marked by zones of alternate density and coloring along the borders, recall somewhat the characters of some of the hard *Fungi* seen upon old trunks of the forests at the present time and known as *Polypores, Bolets*, etc., or generally called *Sponge-Mushrooms.* The characters of this fossil organism are so uncertain that the authors themselves, though applying to it the Generic name of *Polyporites,* consider as very doubtful its reference to the vegetable kingdom.

Mr. Bowman, the discoverer to whom the species is dedicated as *P. Bowmanni,* remarks, that one of his specimens might be taken for the scale of a fish or of some great Saurian. Since that time no kind of remains referable to *Fungi* has been seen in the coal, except one specimen found in the Anthracite measures near Pottsville, Pa. It is apparently identical with the English species and does not afford any more light upon its nature. This specimen, however, contradicts by its habitat its reference to the animal kingdom, as no remains of this kind are found in the Anthracite measures of Pennsylvania.

But there are in the Tertiary Lignitic of the Rocky Mountains some clay beds associated with coal, wherein are intercallated shaly fragments, colored

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have, at our epoch, globular or button-like stems impressed with cicatrices of leaves, and sometimes flattened and depressed at the top toward the central axis, where the tuft of leaves is coming out.. If, therefore, such analogy could be admitted, these specimens would confirm the opinion advanced in considering the probable reference of the branches inscribed above. But this suggestion is too hazardous in its application to remains found in connection with Silurian limestone. For after all, these remarkable fragments may altogether represent one of those organisms like *Uphantænia, Dictyophytum*, etc., whose nature seems to partake of the character of land and marine vegetables, and whose relation is still unknown.

in concentric zones by penetration of iron in such a way that they exactly represent the appearance of the fossils described by the English authors. The zones, about two millimeters wide, are of different hardness, and the soft white ones being more easily disintegrated, they form a series of alternately elevated and depressed concentric bands, similar to those described as characters of the *Polyporites* of the coal.

However this may be, we have now from the Carboniferous a fossil plant which is by all its characters positively referable to the *Fungi*. This plant which was discovered under the bark of a *Sigillaria* is referable to the Genus *Rhizomorpha*, a fungose substance which even until the present time has very rarely been recognized with organs of fructification, and is therefore admitted as a kind of *mycelium* or as the first stage of the life of a *fungus*. Species of various and numerous forms of these vegetable organs are commonly found under the bark of trees or between layers of decaying wood in the forests, and some have been described under different specific names.

RHIZOMORPHA SIGILLARIÆ, sp. nov.

Pl. I, fig. 9.

Stem flattened irregular in form, round, polygonal, elongated and linear or amorphous; branches diverging all around, either simple or forking, even anastomosing in various directions, inflated towards the top, club shaped and obtuse or slightly flattened by compression, and marked upon the surface by a netting of narrow wrinkles resembling veins and their divisions in veinlets.

The figure exactly represents the specimen which botanists will easily recognize as bearing the appearance of some of our present so-called species of *Rhizomorpha*. The surface wrinkles, distinctly seen in fig. 9 b enlarged, seem to have been produced by compression and contact of an upper layer of bark reposing upon them. In their normal state the same appearance is remarked upon living forms of these *Fungi*. It is the same with the flattened body, the mode of branching, the different size and length of the branches, which are evidently widened and modified in their form and directions according to the space left under the bark for their development.

Though no doubt could be entertained about the relation of this organism, which was discovered in detaching the upper layer of bark of a *Sigillaria*, I nevertheless referred the matter to the opinion of some of my corresponding friends, to whom I sent the figure of the plant in order to have every possible evidence on this subject. Among others Dr. Casimir Roumeguère of Toulouse, France, who has large collections of *Fungi* and who is known by numerous scientific memoirs on this difficult branch of botany, answered my request by the communication of many specimens of the different forms of *Rhizomorpha* of our time whose characters are comparable to those of the fossil one. Remarking on its relation as far as it could be recognized from the figure of this organism (the same as that reproduced here) he says: I was extremely interested by the examination of your *Rhizomorpha Sigillariæ* and startled by the appearance of structure which seems to relate that American fossil organism to European congeners; I have especially examined, in comparison, the described forms of *Rhizomorpha subcorticalis*, where I find characters which have removed my first hesitation in regard to your views. One of these forms, the *teredo* of Persoon, has few ramifications, nerves anastomosing, and the primary branches are flattened, enlarged and rugose as in the fossil specimen from Cannelton. The form *latissima* described by Kick, in the flora of Flanders from under the bark of *Betula alba*, has a flattened body resulting from the impression or cohesion of some stems, etc.

From the specimens communicated to me, most of the forms of *R. subcorticalis* present the mode of anatomosis in abnormal direction, as seen at the base of the branch c. Others have a flattened stem when unfolding under some closely pressed piece of bark; but the branches generally take their cylindrical form when they come to more space especially where air is accessible. Though it is always difficult to find the top of the branches they are generally inflated or club-shaped as in the fossil specimen.

Dr. Roumeguére adds to the dry specimen a figure of *R. subcorticalis*, which represents a stem flattened and enlarged, as is the body of our fossil, with branches bearing at the surface small tubercles composing a false *peridium*, one of which, more advanced into maturity, has produced a club shaped body identically similar to those of *Hilaria digitata*, an autonome *Fungus*. This production has been as yet very rarely observed. Except that the ramifications of the branches of that living species are longer and not inflated at the top, which is not discernible in the specimen, the fossil form is remarkably similar to it.

I received also from Professor C. H. Peek, of Albany, some specimens of *Rhizomorpha* more or less representing the character of *R. Sigillariæ*.

No fossil plant published until now from any of the geological formations of Europe or of America has any relation to this. In Sternberg, Vers., *Aphlebia tenuiloba*, represented in Vol. II, pl. lviii, fig. 2, might be quoted as bearing some relations to the plant of Cannelton by its branches irregularly diverging from an enlarged amorphous central nucleus. But though this species, a mere variation of *A. adnascens*, Pr., represents a parasite plant, it has, like the others described under this generic name, a distinct system of nervation, according to which, the divisions of the primary stems are in an outside or upward direction, and therefore do not, and cannot anatomose either in right angle or in abnormal direction, as is the case with plants of cellular tissue. Thus we would have only for comparison, outside of the *Fungi*, marine plants or Fucoids, and of course the presence of marine plants in connection with *Sigillaria*, even under the bark of trees of this kind, is an impossibility.

Habitat. I found this vegetable organism in shaly cannel or cannel shale of the Cannelton coal, of Beaver County, in company with the proprietor, Mr. I. F. Mansfield, who in pursuing systematic researches for fossil remains has obtained a remarkably rich series of rare and new species of plants of the Carboniferous. The character of a rib of Sigillaria is easily recognized upon the figure of the specimen, which bears also one round scar of the under surface. The upper layer of bark transformed into coal was broken in small fragments to fully expose the fossil *Fungus*.

On some new or little known Reptiles and Fishes of the Cretaceous No. 3, of Kansas.

By E. D. Cope.

(Read before the American Philosophical Society, August 17, 1877.)

Toxochelys latiremis Cope.

Final Report U. S. Geol. Surv. Terrs. II. pp. 98, 299.

Two nearly complete crania of this species found by Mr. Sternberg, enable me to give the genus a definite position in the system.

The prefrontals have an extensive mutual contact, and extend to the external nares, where they are somewhat contracted by the superior processes of the maxillary. They descend to the vomer, and are extensively in contact with it. There are no distinct nasal bones. Lachrymal foramen rather small. The temporal fossa is extensively roofed; and the supraoccipital crest much produced backwards.

The posterior nares are rather anterior, and are separated, and not underroofed by the osseous vomer. This element expands in front of the nares, where it separates the maxillaries.

A foramen separates the maxillaries from the palatines, and the ectopterygoids expand laterally. The superior alveolar surface is wide, and slightly concave. The external border is elevated and acute, and the inner border is slightly prominent and is roughened.

The characters above adduced show that the genus *Toxochelys* is one of the *Cryptodira*, and that it is distinct from *Euclastes* (Cope) of the cretaceous No. 5. In that genus the posterior nares are underrun by a production of the vomer, and the alveolar faces of both jaws are much wider. The general form of the skull of *Toxochelys* is much like that of many *Trionychidæ*, but from these the characters of the marginal bones of the carapace, and the form of the extremities separate it.

Ichthyodectes goodeanus sp. nov.

This largest species of the genus is represented by a right premaxillary and a large part of the maxillary bones. The alveolar border is concave at the anterior part of the latter, and then becomes convex. The maxillary border is incurved at its anterior extremity, so that the line of teeth is turned inwards as well as strongly upwards, the middle part of the border being the most prominent. In this respect it differs from the other species, where the anterior part of the alveolar border is the most prominent. The anterior border is sigmoidally curved, and the vertical diameter is twice the transverse. The premaxillary teeth number thirteen and are somewhat compressed so as to have opposed cutting edges; they are without grooves or ridges. The maxillary teeth are round in section. The posterior maxillary condyle is not protuberant, and is decurved anteriorly. The maxillary underlaps the premaxillary to near its anterior border.

Measurements.	M.
Depth of maxillary behind condyle	.047
" " at "	.053
" premaxillary	.069
Length " at middle	.037
Four functional maxillaries in	.020

This species is dedicated to my friend Prof. G. Brown Goode, of Middleton, Conn., collaborator of the Smithsonian Institution.

I may here state that another very distinct species of this genus is the *Ichthyodectes arcuatus* (*Portheus accuatus* Cope. 4to Report U. S. Geol. Surv. Terrs. II. p. 204). It is characterized by the attenuation of the bones of the face, and jaws, and the small size and large number of its teeth. Those of the maxillary bone are so small as to become obsolete on the posterior half in old individuals.

ICHTHYODECTES ACANTHICUS sp. nov.

The smallest species of the genus, distinguished by the attenuated and curved crowns of the teeth. It is represented in my collection by portions of the dentary, parasphenoid, and other bones. The teeth on the anterior part of the dentary bone are nearly round in section, and their enamel is smooth. The crowns are curved inwards towards the apices, which are slender and acute. The anterior tooth is on the extremity of the dentary. The lateral processes of the parasphenoid are wide and flat, and are pierced at the base by the usual two foramina. The interorbital portion of the bone is concave in the section of its inferior surface.

Measurements.	M.
Length of the crown of a tooth	.005
Diameter " " "	.001
Five mandibular teeth in	.012
Width of parasphenoid at middle	.006
Depth of parasphenoid at middle	.004

This species and the last described were obtained by my assistant, Chas. H. Sternberg, from the chalk of the Cretaceous No. 3 of Kansas.

ORICARDINUS TORTUS gen. et sp. nov.

Char. gen. Teeth inserted in shallow aveoli, with the roots more or less exposed; on the posterior half of the maxillary bone unequally so, so as to be pleurodont. The anterior part of the maxillary bone depressed, with superior articular facet, and united with the premaxillary by a ginglymus.

This genus is apparently nearly allied to *Pachyrhizodus* as I have defined it. In that genus the anterior maxillary teeth are strongly pleurodont, and the maxillo-premaxillary suture is squamosal. To *Oricardinus* must probably be referred the *P. sheareri* m.

Char. specif. This is derived from a right maxillary bone and a number of vertebræ, supposed to belong to the same individual by my assistant, Russell Hill, who discovered it.

The proximal extremity of the maxillary bone is depressed, both the external and internal aspects presenting prominent ribs. The inner rib soon disappears, and the alveolar border becomes interior in position, the teeth then assuming a more pleurodont character. The external rib continues, and rises so as to form the superior border of the jaw, but continues to have an oblique direction outwards. It is separated by a longitudinal concavity from the portion that bears the alveoli. The teeth are subcylindric in section, and the crowns are acute and incurved. The proximal end of the maxillary forms a condyle for transverse movement, which is divided by a transverse groove. Above this groove the extremity is fissured.

The vertebral centra are somewhat hour-glass shaped, and present a deep longitudinal fossa on each side of the base of each neural and hæmal arch, which is divided by a vertical rod on partition of bone, which strengthens the arch. The arrangement is that seen in the genus *Empo*, The sides of the centra are marked with rather regular linear grooves, which disappear at the contraction.

Measurements.		M.
Length of maxillary bone preserved		.066
Distal depth		.011
" width		.005
Proximal depth		.005
" width		.006
Eight teeth in		.020
Diameter of caudal centrum	longitudinal	.010
	transverse	.009
	vertical	.010
Diameter of anterior centrum	longitudinal	.009
	transverse	.011
	vertical	.009

In the *O. sheareri* the dental alveoli are transverse to the long axis of the maxillary bone, while here they are longitudinal or round; the bone is more laminiform in the *O. tortus*.

ANOGMIUS FAVIROSTRIS sp. nov.

The characters of the genus *Anogmius* Cope having up to the present time rested upon but one species (*A. aratus*), it is satisfactory to be able to confirm them by the study of new material. This, which was obtained in Kansas by Mr. Sternberg, consists of the almost entire superior part of the skulls of two individuals, one of them with thirteen vertebræ.

The vertebræ, which undoubtedly belong to the skull, have no lateral grooves, but the superior and inferior pairs of fossæ are present. The inferior fossæ are separated by a plane interval on the anterior centra, which rapidly narrows posteriorly. The centra are not elongate nor contracted at the middle, and are sculptured with fine longitudinal grooves.

The cranium is depressed, and was so in life. The form of the muzzle is the extremity of an oval, at the apex of which are the two short premaxillaries, while the sides are composed of the long maxillaries. The top of the head is nearly smooth, marked only posteriorly by a few delicate radiating grooves and dots.

The inferior view displays the vomer, palatine, and maxillary bones with their myriad teeth *en brosse*. Those of the maxillaries form a narrow band, those of the premaxillaries a little wider one. The palatines are long flat bones similar to those of the *Stratodus apicalis*, but of less elongate proportions, and the teeth they bear are relatively smaller and not in longitudinal rows as in that fish. The teeth of the median line of the palate form an elongate tongue-shaped patch, flat and acuminate in front, but gently convex, and with lateral bevels more posteriorly. The teeth it supports are very close together as on the palatine bones. The posterior portion of this patch is broken away. The mandibular ramus is not deep and the symphyseal surface is a rectangular truncation of the nearly parallel inferior and superior edges. The teeth are in many rows, the number diminishing posteriorly. The dentary is incurved to the symphysis. The premaxillary bone is not smooth like the others of the cranium, but is pitted anteriorly, and radiately ridged posteriorly.

Measurements.		M.
Length of cranium		.102
Width of cranium behind		.050
Length of premaxillary bone		.015
Depth of the dentary		.009
Length of palatine bone		.052
Width " " "		.010
" " vomerine dentate patch		.010
Diameter of a cervical vertebra	longitudinal	.005
	transverse	.009
	vertical	.007

ANOGMIUS EVOLUTUS Cope.

This fish is represented by an entire left mandibular ramus. As corresponding parts are preserved in the typical specimens of *A. aratus* and *A. favirostris*, comparison with these species is easy.

The ramus is less curved than in either of the species mentioned, indicating an elongate and wedge-shaped head. The symphysis is short; deeper than wide, and but little incurved. The ramus is much contracted vertically at the glenoid cavity, which is deeply impressed and decurved on the inner side, having thus a convex transverse section. The angle is recurved behind the glenoid cavity, and also produced for a short distance in line with the inferior margin of the ramus, this portion being separated by a sinus from the superior process. The form of the angle is then that of a boot with the toe elevated. The inferior edge of the inferior process is acute.

The inferior border of the ramus is thin. The superior border is thickened, and its tooth bearing surface descends on both the internal and external faces of the bone. Posteriorly, this face is presented inwards, but this tooth-band narrows forwards on this side, and widens on the external face. Its greatest width on the latter is posteriorly, an inch in front of the widest internal exposure; it then gradually contracts, its inferior border rising to a short distance behind the symphysis.

The dental alveoli are small and round, densely packed, and sub-equal in size. Near the middle of the ramus, thirty longitudinal rows may be counted. Not a tooth remains. A transverse section of the greater part of the length of the dentary is strongly convex; anteriorly it is flattened above.

Measurements.	M.
Length of ramus	.234
" " tooth band	.150
Depth of symphysis	.016
" at posterior end of tooth band	.050
" at glenoid cavity	.019
" at angle	.030

STRATODUS OXYPOGON Cope.

This fish is represented in Mr. Sternberg's collection by a dentary bone, a probable maxillary, and a portion of the palatine, both the latter without their extremities. A number of vertebræ accompany the jaws, which probably belong to the same individual.

The dentary is narrow and cuneiform, and rather robust for its depth. The tooth band is wide, covering more than half the vertical diameter of the bone, and is bounded below by a groove. The external face is convex. A delicate groove extends along the superior margin just below it; and a wide open groove commences behind the middle of the length and above the middle of the vertical diameter, opening widely behind. The inferior edge is compressed and flat, and is abruptly distinguished from the convex portion. The symphyseal surface is short, and the infero-anterior border is produced into an acute angle. The teeth are in six rows on the widest part of the band. Of these one contains larger teeth than the others; at one point it is the second from the external margin, but its position becomes more interior on the anterior part of the band. The teeth are recurved, round in section, and with simple, very acute apices. These are transparent and vitreous; the remaining portion of the tooth is opaque, and marked with whitish dots. At the anterior extremity of the dentary, but two rows of the smaller sized teeth remain.

The alveolar fossæ of the teeth of the three interior series of the dentary band, have a peculiar character. The internal half of the border has short radiating lines touching its circumference, but the external half supports three convex lobes of dense tissue. The lateral of these are divergent and dorsal; the median is narrower, and is radial to the circumference. This structure does not appear in the alveolar fossæ of the three external rows. It is probably a hinge like attachment permitting elevation and depression of the teeth of the inner rows.

The supposed maxillary bone presents a wide open groove on both sides The superior border is convex in section and not so wide as the tooth bearing face, which is slightly oblique. But for this obliquity the section would be that of a T-rail. The groove of the internal face is continued further forward than that of the external face. There are six rows of teeth arranged as in the dentary bone, but in reversed order.

The fragment of palatine bone is densely packed with teeth, which are longer than those of the jaws. Their apices are as in the latter, simple. Those of one border are longer than those of the other, and the alveolar fossæ of these (the only ones I can see) bear the three adjacent tuberosities above described.

The vertebræ considerably resemble those of *Empo*. Their centra in both abdominal and caudal regions are elongate and contracted medially. There is a shallow longitudinal groove at the bases of the neural and hæmal arches, which are divided vertically by a median rib-like buttress. The median lateral portion is smooth or nearly so.

Measurements		M.
Length of dentary bone preserved		.0550
Depth " " " at middle		.0080
" " dentary tooth band at middle		.0050
" " " at symphysis		.0045
Length of maxillary bone preserved		.0530
" " " tooth		.0045
Depth " " at middle		.0060
Width " " " "		.0050
" " palatine bone		.0100
Diameter of an abdominal vertebra	longitudinal	.0160
	transverse	.0115
	vertical	.0125

This species differs from the *S. apicalis* in the simple form of the apices of the teeth. The type specimen is much smaller than that of *S. apicalis*.

Descriptions of Extinct Vertebrata from the Permian and Triassic Formations of the United States.

By E. D. Cope.

(*Meeting of the American Philosophical Society, November 2d,* 1877.)

The Triassic formation of North America has yielded many of the reptilian types which characterize the horizon in other parts of the world. A Labyrinthodont has been recognized in North Carolina, and I have determined the existence of the genus *Belodon* in the formation in both that State and Pennsylvania. Of *Dinosauria* three types occur in both Europe and North America. The *Palæosaurus* of the former country is represented by the American *Clepsysaurus*, and *Zanclodon* is somewhat similar in dental characters to the *Zatomus* of North Carolina. Of genera with compressed teeth which have a lenticular section, and both edges denticulate, *Bathygnathus* has been found in North America, and *Cladiodon* and *Teratosaurus* in Europe. This type has, however, been wanting heretofore from the extinct Triassic fauna of Pennsylvania and North Carolina. The present communication introduces it for the first time from the former State, under a form generically different from any of the preceding, and with the name

Palæoctonus appalachianus.

The specimens on which this determination rests, were found by my friend Charles M. Wheatley, A. M., in one of his copper pyrites mines. The most characteristic are two teeth which differ somewhat from each other in form. One of them has a greater transverse, and less anteroposterior diameter, indicating an anterior position in the series. The other is more compressed, and presents a greater anteroposterior width. Judging by the analogy of the genus *Lælaps*, this tooth occupied a position posterior to the first one. The two were found in close proximity, though not in actual contact, in a fragile, argillaceous portion of the copper-bearing rock.

The profile of the anterior tooth is regularly conic with a slight recurvature, which is not seen in the apex, but in the basal portion of the crown, and in the root. The section is almost semicircular at all points, but the inner and flatter face is slightly convex; rather strongly so at the apex. The denticulation of the edges is minute, measuring M. .00033. It continues to the base of the crown both fore and aft. At this point the edges are as elsewhere, at one side of the anterior and posterior aspects. There are no ridges nor facets on the crown, and the enamel possesses an obsolete minute rugosity of short linear ridges.

The crown of the second tooth is not only flatter and wider than that of the first, but is little more than half as long. Both edges are crenate to the base. The marked peculiarity of the tooth is seen in the division of the crown into facets by angular ridges. The convex face is divided into two, an anterior-looking and a posterior-looking, the former half as wide as the latter. The angle separating them is not continued on the apical third of the crown. The section of the antero-external face is nearly plane. The division of the interior or flatter face is similar, but the angle is less pronounced. The anterior and narrower face is slightly concave. In this crown, as in the first described, there are weak transverse undulations near the basal third.

Measurements.		M.
Length of anterior tooth preserved		.080
Length of crown of same		.055
Diameter of base of crown	antero-posterior	.022
	transverse	.016
Diameter near apex of same	antero-posterior	.010
	transverse	.008
Length of posterior tooth preserved		.040
Length of crown of second tooth		.029
Antero-posterior diameter at base of crown		.025
" " at middle of crown		.019
Transverse diameter " " "		.010

These dimensions indicate an animal of the general proportions of the gigantic carnivorous *Dinosauria* of the genera *Lælaps, Megalosaurus* and *Teratosaurus*. They exceed those of the *Bathygnathus borealis* and the only known species of *Cladiodon, C. lloydii*.

The characters which demonstrate that this Saurian belongs to a genus distinct from any of the above are, Firstly, the presence of the external and internal longitudinal ridges which divide the crown of the posterior tooth into four facets. Second, the shortness of the crown as compared with its width, a point in which it approaches *Palæosaurus*. Thirdly, the semicircular section of the anterior tooth, a form not found in either *Bathygnathus* or *Teratosaurus*, where almost the entire series is known. It is only approximated in some of the Western species referred to *Lælaps*, but is not inconsistent with the characters of that genus as represented by them.

To the genus thus characterized, the name *Palæoctonus* is given, and to the species, the name *Palæoctonus appalachianus*.

Associated with the teeth of this species, were found several leaves resembling those of *Pterophyllum;* and stems of *Calamites* occur in the same locality.

Additional specimens received from Mr. Wheatley include anterior, intermediate and posterior teeth of a larger animal than the one above described, and intermediate and posterior teeth of a much smaller individual of probably the same species.

The large half-conical tooth of the large individual, presents a slight groove-like constriction at the basal portion of the posterior cutting edge. Length of crown above base .060; width at base .025. Width of posterior tooth at base .030. The form of the intermediate tooth is between those of the others. Its external face is very convex and is not faceted. The approach of the external face to the anterior or cutting edge is much more abrupt than to the posterior.

The teeth of the smaller saurian only differ from the others in their size. The more posterior is probably anterior in position to those described above, as its external face is more convex, especially anteriorly, and is not faceted. Length of crown of the anterior tooth .032; width at base .019. Width of base of posterior tooth .015; length .019.

PALÆOCTONUS AULACODUS, sp. nov.

The teeth of this saurian differ from those of the *P. appalachianus* in having their basal portion sculptured with parallel shallow grooves. These are quite close together, leaving ridges between them which are narrower than themselves. The surface of the crown displays the silky sculpture of minute raised lines more distinctly than in the other species. But one tooth of this animal has been so far obtained by Mr. Wheatly, and this one is from the middle of the series of an animal rather smaller than the second individual of the *P. appalachianus*. In accordance with this position the crown is short and half conic with the external face strongly convex, most so in front. The denticles are well exhibited on both edges, but only descend on the anterior to the middle of the length of the crown. In both large and small specimens of P. *appalachianus* the denticles descend nearly or quite to the base. Length of crown .022; width at base .011.

CLEPSYSAURUS VEATLEIANUS, sp. nov.

Represented by a single large tooth in perfect preservation. In accordance with the characters of the type species, *C. pennsylvanicus* of Lea, the tooth is straight, and possesses two cutting edges. The posterior of these is denticulate and perfectly straight; the other is less extensive and is separated from the posterior by very unequal surfaces.

In the present saurian the tooth is compressed, and rounded in front, the section throughout the basal half being an oval with one end acute. The antero-interior edge only exists on the apical half of the crown, and is separated from the posterior edge by a somewhat convex face two-thirds the width of the external face. It is not denticulated, and its lower extremity falls behind the anterior margin of the crown when viewed in profile. The enamel is perfectly smooth. Length of crown from base of enamel layer .047; longitudinal diameter at base .018; transverse do. 011.

As compared with the *C. pennsylvanicus* of which several teeth are known, the *C. veatleianus* differs in its more compressed form, and in having the anterior cutting edge not denticulated. The position of this edge is more internal than in the longer known species, but this may indicate a more anterior position in the jaw.

This saurian is named in compliment to Charles M. Wheatley, A.M., of Phœnixville, Pa., to whose exertions we owe nearly all the material hitherto obtained from the Triassic formation of Pennsylvania.

SUCHOPRION CYPHODON, gen. et sp. nov

Char. gen. As no portion of the animals referred to this genus is known, other than teeth, the characters are derived from these only. Their crowns are elongate, conical and curved, and are furnished with denticulate cutting edges. In the teeth preserved these are separated by very unequal extents of surface, as they form the anterior and posterior borders of the inner face. The crown is penetrated by a very minute pulp cavity, and it consists of a number of distinct concentric cones.

It is probable that teeth have been discovered in Europe which belong to saurians of this genus, but I cannot find that they have ever received a distinctive name. They resemble those of *Crocodilia* rather than *Dinosauria.*

Char. specif. The only species of *Suchoprion* as yet known to me is represented by four teeth found in the same beds and formation as those above described. One of these is of large size, indicating that it reached the adult dimensions of the Gangetic gharrial. They display some difference in the degree of convexity of the external surface, which is sometimes opposite the imaginary plane of the inner face, sometimes oblique to it. The degree of convexity is always greatest at the base of the crown. The inner face is also convex. The curvature in the long direction is not great, and is directed to the inner side. The surface presents a minute silky sculpture; one tooth presents a very few shallow sulci.

Measurements.		M
Diameter of largest tooth	antero-posterior	.021
	transverse	.020
Length of crown of tooth No. 2		.045
Diameter crown tooth 2	antero-posterior	.009
	transverse	.016

BELODON CAROLINENSIS, Emmons.

Cope, Trans. Amer. Philos. Soc. 1869, p. 59.

Teeth of the anterior portions of the jaws were obtained by Mr. Wheatley.

BELODON PRISCUS, Cope.

Trans. Amer. Philos. Soc. 1869, p. 59.

Teeth from the anterior part of the jaws. In addition to the six species of saurians above noted, Mr. Wheatley obtained the tooth of a Stegocephalous Batrachian, probably a Labyrinthodont.

CRICOTUS GIBSONII, Cope, sp. nov.

While examinations into the Clepsydrops shale of Eastern Illinois have revealed a great abundance of individuals, and three species of *Clepsydrops,* the genus *Cricotus* has remained without addition, and the three vertebræ hitherto found, appear to belong to but one species, the *C. heteroclitus.* The present notice describes a second form, represented, like the first, by but few remains. The vertebra which is best preserved, and which may be regarded as typical, is probably from the caudal series, and is thus well contrasted with the corresponding typical vertebra of the longer known species.

On this vertebra there is no trace of diapophysis, and the neurapophysis rises from the external side of the superior face. The wall of the neural canal is not preserved, but the inference is that the diameter of the latter is large. This fact and the absence of definite chevron articulations leads me to doubt the caudal position of the vertebra; but the usual marks of the dorsal and cervical vertebræ are totally wanting from it. As in *C. heteroclitus*, the *foramen chordæ dorsalis* is large, its diameter being one-third of the total. The articular faces descend steeply into it, that of one extremity more so than the other. The rim of the latter face is beveled outwards, the plane thus produced appearing on the inferior face something like the united faces of the chevron bones.

The centrum is a little deeper than wide, and the inferior face is truncate so as to give a subquadrate outline. The inferior plane is concave, the concavity being divided by a longitudinal rib. The sides are somewhat concave, with a longitudinal rib at the middle. Diameters of centrum: vertical .010; transverse .009; longitudinal .008. Width of inferior plane .005; width above, including neurapophyses, .008.

As compared with *C. heteroclitus* this species differs in the presence of parallel ridges enclosing a median fossa on the inferior side of the centrum. The small size may be here considered, but it is uncertain whether the two animals represented by the vertebræ are fully grown.

This reptile is named in recognition of the services of William Gibson of Newport, Ia., who has added a number of interesting facts to the geology of the Wabash region.

CRICOTUS DISCOPHORUS, Cope, sp. nov.

A vertebra, representing an animal as large as the *C. heteroclitus*, presents characters so much at variance with those of the latter as to require special notice. Three other vertebræ of smaller size present similar features.

The centrum is disciform, with very short antero-posterior diameter, which is, however, greater at one part of the surface than at the opposite point. The foramen chordæ dorsalis occupies about one-fifth of the transverse diameter, which is subequal in all directions. The articular faces of the centrum are slightly concave. The margin of that of one side is beveled for the superior two-thirds of the circumference, the bevel running out below by turning into the articular face. The latero-inferior border of the latter turns out into an obtuse angle at this point. The superior part of the bevel runs into the lateral face of the centrum. The attachment of the neural arch is obscure or wanting in the specimen, and the same is true of any facet for chevron bones.

Diameter of articular face	vertical	.025
	transverse	.025
Length of centrum below		.009
" " above		.007

Another vertebra of nearly the same character, and one-half smaller size, presents a greater difference between the long diameters of the upper and lower sides. The superior diameter is only one-half the inferior, and the foramen chordæ dorsalis much nearer the superior than the inferior margin. Its diameter is one-fourth the vertical and one-third the transverse diameter.

From the same locality and discoverer as the *C. gibsonii*.

LYSOROPHUS TRICARINATUS, Cope, gen. et sp. nov.

Char. gen. Vertebræ amphicœlian, perforated by the foramen chordæ dorsalis. Neural arch freely articulated to the centrum. Floor of neural canal deeply excavated. No processes nor costal articulations on the centrum, which is excavated by longitudinal fossæ. Centrum not shortened.

This genus resembles in the proportions of the centrum, the genus *Clepsydrops*, but differs in many details.

Char. specif. Two centra and a portion of a third represent this species. The former are a little longer than wide and a little depressed. The facet for the neural arch is an elongate plane truncating the border of the fossa of the neural canal on each side, for one-half to three-fifths the length of the centrum. Two deep longitudinal fossæ extend on each side of a median rib of the inferior face ; and they are separated above by a narrower rib from another longitudinal fossa which is below the base of the neural arch.

Measurements.		M.
Diameter of centrum	longitudinal	.0055
	vertical	.0038
	transverse	.0040
Length of facet for neurapophysis		.0035
Width of neural canal		.0020

Discovered by Wm. Gurley, near Danville, Illinois.

DIPLOCAULUS SALAMANDROIDES, gen. et sp. nov.

Char. gen. Vertebral centra elongate, contracted medially, and perforated by the foramen chordæ dorsalis ; coössified with the neural arch, and supporting transverse processes. Two rib articulations one below the other, generally both at the extremities of processes, but the inferior sometimes sessile. No neural spine nor diapophysis ; the zygapophyses normal and well developed.

The vertebræ of this genus much more nearly resemble those of a salamander than any hitherto found in this formation, but it will be necessary to observe the cranium before this point can be determined.

Char. specif. One of Dr. Winslow's and two of Mr. Gurley's sendings contain vertebræ of this species. One from the latter gentleman is contained in a mass of clay in immediate contact with a mandibular ramus which supports a number of teeth. The ramus appears rather too large for the animal to which the vertebra pertained, but the proportion is not different from that which I describe below in the genus *Eryops*.

The surface of the centrum is smooth and is without grooves. The diapophyses and parapoyhyses are rather elongate, and are closely approximated one above the other. The superior process issues from the centrum opposite the superior margin of the articular faces. They stand equidistant from the extremities of the centrum, and are directed obliquely backwards. The anterior zygapophyses occupy the same level. The neural spine is a compressed longitudinal ridge ; it divides behind, leaving a notch between the posterior zygapophyses.

Measurements.		M
Diameter of centrum	longitudinal	.0060
	vertical	.0025
	transverse	.0025
Depth of centrum and neural arch		.0060
Width with transverse processes		.0070
Expanse of posterior zygapophyses		.0050

The mandibular ramus which accompanied one of the vertebræ is shallow and stout. Its external surface is sculptured with sharp longitudinal ridges, which inosculate more or less. The teeth have cylindric roots which occupy shallow alveoli sunk in a plane surface. The crowns are rather elongate and compressed near the apex, and without grooves or serræ. In contact with the jaw is an osseous fragment with a pitted or reticulated surface.

Depth of ramus	.0030
Length of crown of tooth	.0023
Four teeth in	.0040

ERYOPS MEGACEPHALUS Cope gen. et. sp. nov.

Char. gen. The details of the structure of this genus are derived from an almost entire cranium with underjaw, which is accompanied by numerous vertebræ and other bones. The form is Labyrinthodont, and embraces the largest species of that group yet known from this continent.

The skull is not elongate, and the quadrate bones are produced far backwards. The epiotic processes are present but not remarkably elongate. The temporal fossa is covered in by the usual roof. The orbits are round, posterior in position, and small. There is no postorbital depression or groove, and the lateral epiotic sinus is not deep. The nostrils are large and widely separated. There is no angular process of the mandible. The maxillary teeth are of different sizes, although arranged in a single row. The posterior are small and not closely placed ; large teeth appear anterior to the middle. The premaxillary bone supports a number of large teeth. Those of the mandible which are visible in the specimen in its present state, those opposite the nares, are of medium size. The form of the crowns of the teeth is conic, with weak fore and aft cutting edges. There are no distinct fissures of the surface although these may be represented by some fine parallel lines.

Vertebræ referred to this genus are small in proportion to the dimensions of the skull. They are not discoidal but somewhat elongate; are biconcave, and are not perforated for the notochord. The middle portion of the centrum is contracted. One articular extremity has the borders of the concave centre, convex. Zygapophyses large. Ribs present short; neural spines elongate, stout.

In comparing this genus with those described by authors and arranged by Mr. Miall in his family *Euglypta*, its exclusion from the latter is evident in view of the absence of angular process of the mandible, and the nondiscoidal vertebræ. Its posteriorly placed orbits distinguish it from the genera of his second family, the *Brachyopina*, excepting perhaps *Rhinosaurus*. It is with the genera of the third family, the *Chauliodonta*, that affinity appears to exist. It is unnecessary to compare *Eryops* with *Loxomma*, which has immense and irregularly shaped orbital openings, and trenchant teeth; but with *Zygosaurus* and *Melosaurus* the affinity is closer. The deep postorbital depressions, and the grooved maxillary teeth, described by Eichwald in the former genus, separate it at once. The teeth of *Melosaurus* are equally distinct, being, according to Meyer, conical and deeply grooved at the base. In *Rhinosaurus* the maxillary and mandibular teeth are said to be sub-equal. *Leptophractus* has deeply grooved teeth with strong cutting edges.

Char. specif.—In this category I include many of those introduced into the generic diagnosis by Mr. Miall in the very useful report to the British Assoc. for the Advancement of Science, 1874, p. 149, by the Committee on the Structure and Classification of the Labyrinthodonts. Such are the width of the interorbital space, the outline of the muzzle, the details of the sculpture, the approximate number of the teeth, etc.

The cranium has a sub-triangular outline, with the sides a little longer than the base, and the apex (muzzle) very obtuse. The profile is elevated behind, and the sides slope steeply to the mandible; the slope of the muzzle is rather steep, but less so than that of the cheeks. The extremity of the snout is broadly rounded and depressed, and overhangs the mandible. The supra-occipital outline is concave, and the epiotic angles only moderately prominent. The quadrate bones extend far posteriorly, and are horizontal above at their distal extremities. The orbits are nearly round, although somewhat wider than long, and they are directed equally outwards and upwards. The inner margin is slightly flared upwards, and it terminates anteriorly and posteriorly in a slight tuberosity, at the junction with the canthus rostralis and temporal ridge respectively.

The orbit occupies the anterior portion of the posterior third of the length of the skull, including the epiotic angles; and its long diameter is one-seventh that of the skull from the epiotics to the muzzle inclusive. The same diameter is about half of the interorbital width. The parietal region is plane, the frontal gently concave, and the muzzle depressed convex in cross-section. The face in front of the orbit is concave below the canthus rostralis. The nostrils are not large, and are sub-round. They are widely separated, being nearer the maxillary border at its junction with that of the premaxillary, than to the median line. The mandible is shallow, and not very stout. Its inferior border rises from below a point a little in front of the fundus of the epiotic sinus to the angle, which is at the quadrate articulation. Symphysis short.

The sculpture of the anterior portions of the muzzle is coarsely punctate; on the posterior portions of the upper and lower jaws it is ridged and pitted. Most of the upper surface of the skull is still covered with a thin layer of the matrix, so that the sculpture and the character of the lyra, if any there be, remains unknown.

The teeth, as has been observed, are not visibly grooved, but the characteristic feature of the group may be represented by numerous delicate crack-like lines which one sees on the basal portions. These, however, look like the result of weathering. The sections of all the teeth would be round, but for the cutting edges, which are not very prominent. In addition, the premaxillary teeth are coarsely fluted on the median half of their length. The fluting is not visible on an antero-lateral mandibular tooth, nor on a posterior maxillary tooth. The microscopic structure of the teeth is not yet investigated.

The bodies of the vertebræ have concave sides, and a sub-round section. Their neural spines terminate in an obtuse enlargement. Many of the characters of the vertebral column are yet concealed in the matrix. The distal portions of the ribs are straight, cylindric, and become stouter at the extremity.

Measurements.	M.
Length of cranium from the extremity of the os quadratum	.433
Length of cranium on middle line	.335
Length from end of muzzle to nostril	.073
Width of cranium between quadrates	.306
" " " epiotics	.118
" " " orbits	.086
" " at orbits	.294
" " between nares	.085
Diameter of orbits antero-posterior	.048
Diameter of orbits transverse	.057
Length of premaxillary tooth	.025
Diameter " "	.007
Length of posterior maxillary tooth	.010
Diameter of median " "	.007
Length of a dorsal centrum	.024
Vertical diameter of do.	.025
Elevation of neural spine of do.	.050
Length of rib on curve	.080

This interesting fossil was found in the Triassic formation of Texas by my friend Jacob Boll. The cranium and vertebræ were discovered in such relation as render it evident that they were parts of one animal.

STRIGILINA GURLEIANA, Cope, sp. nov.

This species is known by a single jaw or tooth in complete preservation, which was found, like the type of the genus *S. linguæformis** near Danville, Ill., by Mr. Gurley.

The tooth is quite small, its length only equaling the width of the known tooth of *S. linguæformis*. It is also narrower in proportion to the length. The root and the cutting edge are turned in opposite directions as in the other species. The principal difference between the two is seen in the character of the transverse ridges or crests of the oval face. There are two crests less, or five, with a delicate basal fold, making six, while, counting the fold there are eight in *S. linguæformis*. The anterior ridge is transverse; the others slightly convex backwards, and all are equidistant and uninterrupted, which is not the case in the older species. They are also of different form, being distinct ridges with anterior, and posterior faces similar. In *S. linguæformis* the anterior face only is vertical, the posterior descending very gradually, the whole forming a series of steps. Length of ridged face .0060; width anteriorly .0035; width posteriorly .0020.

This species is dedicated to William Gurley, of Danville, Illinois, to whose zeal science is indebted for the species from that locality described in this and other papers.

Twenty species have now been obtained from the Clepsydrops shales, the exact geological position of which remains to be accurately determined. Dr. Winslow informed me that they are the bed No. 15 of Prof. Bradley's section of the Carboniferous rocks of Vermilion county, Illinois. This places them near the summit of the Carboniferous series, below two thin beds of coal (which word is misprinted "coral" in my last paper, Proceed. Amer. Philos. Soc. 1877, p. 63). I am now informed that this portion of Prof. Bradley's scale is not correct, and that No. 15 occupies a much higher position than he assigns to it. It lies unconformably above the merom sandstone of Mr. Collett, which deposit is above the coal measures and unconformable to them. The stratigraphical evidence is thus conformatory of that derived from paleontology, that the *Clepsydrops* shale occupies a position in the scale above the coal measures.

CTENODUS PUSILLUS, Cope, sp. nov.

Form narrow, the width of the base about equal to the depth. The coronal portion is narrower than the base, because the inner face is oblique, forming an acute angle with the inferior plane. There are but four crests, of which the two longer are directed in one direction, and the two shorter in another. The interior ones of both pairs form a continuous crest which is convex inwards. The crests are straight, elevated and acute ; each one supports two or three denticles, which are rectangular and little elevated. The longer ones project beyond the general outline ; the shorter ones are less prominent at the extremities ; all are obtuse in the vertical direction. The superior surface is smooth. The inferior is slightly concave in the transverse sense. The tooth on which this species is found is the smallest yet obtained from the formation. Length, .007 ; width, .003 ; depth at inner crest, .003.

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*Proceedings Amer. Philos. Soc. 1877, p. 52.

Two specimens were found by Wm. Gurley, in Vermilion Co., Illinois, in the *Clepsydrops* shale.

I have referred two species from this formation to the genus *Ceratodus*, under the names of *C. vinslovii* and *C. paucicristatus*. While the form of these teeth is that of the genus named, the structure of the superficial layer differs in wanting the punctæ which are characteristic of *Ceratodus*, but is, on the contrary, uniformly dense, although frequently irregular. I therefore refer the two species above mentioned to another and allied genus, under the name *Ptyonodus*, with *C. vinslovii* as type.

ORTHACANTHUS QUADRISERIATUS, Cope, sp. nov.

Represented by an incomplete radial spine. With it occur several fragmentary spines which resemble very closely one belonging to *O. gracilis*, Newb. (Geolog. Survey of Ohio, Pl. lxix, fig. 7), and which only differ in having the denticles shorter. As teeth of a *Diplodus* near to or identical with *D. compressus* are common in the shale, the two may belong to the same fish. Dr. Newberry has already suggested that *Orthacanthus* and *Diplodus* are identical.

The *O. quadriseriatus* is quite different from the other species. The spine is wider than deep, and the series of denticles are widely separated. The surface between them is gently convex and smooth. The anterior face is strongly convex and presents at each side two shallow furrows. The external groove is divided by a series of thin longitudinal denticles which are smaller than those of the principal row, and which are sometimes somewhat confluent at the base. The principle denticles are closely placed, stout, acute, and recurved. Transverse diameter of shaft .0035 ; antero-posterior diameter .0025. The portion of the shaft preserved is straight.

ARCHÆOBELUS VELLICATUS, gen. et sp. nov.

"Species No. 4," Cope, Proceed. Amer. Philos. Soc. 1877, p. 55.

Several other specimens of the body described as above have been obtained by Messrs Winslow and Gurley. In every instance it is a tooth-like process attached to a solid base by anchylosis in the manner of the teeth of fishes. From the appearance it presents I am led to suppose that it is the only one of its series, and there are none of the numerous teeth of the collections which can be associated with it. I therefore distinguish the genus by a name and the following diagnosis.

The form is conical, and the surface is not grooved nor furnished with prominent ridges. The interior is hollow, and the walls are composed of a few concentric layers without external enamel or cementum. The solid base to which it is attached is shallow, presenting smooth surface on the opposite side, which is deeply impressed by a longitudinal groove at one end.

The characters of this species are pointed out at the place above quoted. The measurements of a large specimen are: length .015; diameter of base, long .008; short .005.

I am not sure as to the part of the skeleton to which this body should be referred.

CLEPSYDROPS LIMBATUS sp. nov.

The discovery of a species of the genus *Clepsydrops* in Texas, in a formation hitherto regarded as Triassic, adds weight to the view above expressed, that the *Clepsydrops* shales of Illinois belong either to the Triassic or Permian formations. As typical of the new species I select a vertebra, which may be exactly compared with corresponding one of *C. collettii.* The centrum is about as wide as long, and its sides are very concave, much more so than in *C. collettii,* and the rim-like borders of the articular extremities are connected by a straight compressed hypopophysial keel. The sides of the foramen chordæ dorsalis are convex in the longitudinal section, thus contracting the opening, as compared with the very wide flare of the border of one of the extremities of the centrum. This flare receives the wide recurved border of the opposite extremity of the adjoining centrum, forming a kind of ball and socket articulation. This reflected surface forms a ridge with the funnel of the foramen at this extremity of the vertebra. The concave extremity is produced downwards, so that the foramen is considerably above the middle point. The diapophysis and parapophysis are not distinct nor elongate, but are represented by a projecting scar on the superior part of the centrum, which is directed downwards and forwards towards the rim of the articular face.

Besides the great contraction of the centrum, its relatively shorter form distinguishes it from that of *C. collettii.* It is also much larger than that species and the *C. pedunculatus,* being the largest of the genus.

Measurements.		M.
Length of centrum		.031
Diameter of centrum	vertical	.039
	transverse	.033
Width of neural canal		.006

Discovered by Jacob Boll.

On Reptilian remains from the Dakota Beds of Colorado.

BY E. D. COPE.

(*Meeting of American Philosophical Society, November* 2, 1877.)

Since the discovery of the huge saurian *Camarasaurus supremus* (Cope, Paleontological Bulletin, No. 25, p. 5), Superintendent Lucas has explored the horizon of the Dakota of the Eastern Rocky Mountains near the Arkansas River for other indications of extinct life. His search has been rewarded by the finding of several species of reptiles of interesting character, which it is the object of the present paper to describe.

CAULODON DIVERSIDENS gen. et. sp. nov.

This large saurian is represented by ten teeth found together, but separated from the cranial bones, and in a more or less broken condition. I select four of these exhibiting the characters most clearly.

Char. gen. Fang of the tooth of great length and hollow, and contracted at the base. It is without excavation for successional tooth. Crowns of the teeth of different forms in different portions of the jaw; the posterior are like the bowl of a spoon; others have a similar form but are more compressed, having double lateral ridges, while the crown of another, supposed to be an incisor, is little wider than the root, and has the section an oval with one side less convex than the other. All are coated with an enamel-like layer of considerable thickness which extends on the fang in some of the teeth. None of the crowns present cutting edges.

The characters presented by these teeth are quite distinct from anything hitherto found in North American Saurians. The absence of indication of the successional teeth is remarkable, and in connection with the contraction of the base of the root, suggests that the mode of succession of teeth approximated that exhibited by the *Mammalia*.

Char. specif.—The roots of all the teeth are cylindric. The crown of the posterior tooth is convex on one (the external) side, and concave on the other. The convexity is increased by a contraction of the external surface near and parallel to each border. The concavity is divided by a longitudinal rib which disappears at the base. This edge of the crown is obtuse, as is also the apex. The outline of the apex is rather broadly acuminate. The enamel is closely and strongly rugose, longitudinally on the base, transversely at the edges, and reticulately on the middle portions of the crown.

Measurements.		M.
Length of crown with portion of root		0.120
Diameter of root at middle		.025
Length of crown		.055
Diameter of crown	longitudinal	.030
	transverse	.020

The crown of the second tooth is a little less expanded laterally, and has a greater transverse diameter. The outer side is more convex, and there are two marginal ribs on the basal half of the crown. The interior are not strictly marginal, but are situated within the exterior ribs. Both are very obtuse, and they are separated by a shallow groove. There is no median longitudinal rib.

Measurements.		M.
Diameter of crown at middle	antero-posterior	.026
	transverse	.018

The third type is smaller in all its dimensions, and the crown is equal to the root in long diameter. In my single specimen the distal portion of the crown is lost; the part which remains exhibits neither contraction nor expansion of outline. The borders are very obtuse, and each surface resembles a roll inwards which is bounded by a shallow parallel groove on the inner face of the tooth. Between the grooves the surface is slightly convex. The section is thus an oval with one side very little convex. The enamel is thick and marked with longitudinal rugosities.

Measurements.		M.
Length of fragment		.060
" " root		.030
Diameter "		.014
Diameter of crown at middle	longitudinal	.0135
	transverse	.0085

TICHOSTEUS LUCASANUS, gen. et sp. nov.

Char. gen.—The characters of this genus are derived primarily from the vertebræ. They are nearly amphiplatyan, but one extremity of the articular face is slightly concave, while the other is still more slightly convex or concave. The borders of the former are expanded, while those of the latter are not enlarged. The centrum is hollow, but the chamber does not communicate with the external medium by a lateral foramen, as in *Camarasaurus*. The neural arch is attached by suture. There is no capitular articulation on the centrum.

Char. specif.—There is no hypapophysis on either dorsal or lumbar vertebræ preserved, and the surface is smooth excepting some delicate longitudinal ridges extending to the border of the expanded extremity. The narrower extremity of a dorsal vertebra is nearly round and presents a slight median tuberosity; the opposite end is wider than deep, and its surface is uniform. The smaller extremity of a lumbar vertebra is slightly concave.

Measurements.		M.
Diameter of dorsal centrum	longitudinal	.023
	vertical	.020
	transverse	.025
Width of base of neural arch with diapophysis		.010

This species is dedicated to its discoverer, O. W. Lucas, of Canyon City, Colorado, the Superintendent of the Public Schools of the surrounding region. Through the scientific interest and energy of this gentleman the extinct vertebrata of the Dakota division of the Cretaceous Period hitherto unknown to science are being brought to light. The care and skill exercised by Mr. Lucas in the preservation of remains, which are often bulky, and always fragile, deserve the thanks of all students of this department of science.

COMPSEMYS PLICATULUS, sp. nov.

Although tortoises have been discovered in older formations in Europe, the present species is the earliest yet obtained in North America. Its characters appear to coincide in important respects with those of the Lignitic formation which I have referred to *Compsemys* Leidy. This name I have proposed to retain for tortoises with marginal bones completely united with solid plastron, and the usual dermal scuta, and which differ from *Emys* in their Trionyx-like sculpture.

The *C. plicatulus* is represented by portions of both carapace and plastron of several individuals. While the distal extremities of the costal bones display the suture for the marginals, they also possess an inferior true costal prolongation, as in Trionyx. The proximal part is not preserved in any marginal bone, but the adjacent portions were united by fine suture. The proximal extremity of the costals exhibit the usual two directions, the shorter being posterior, and relating to the anterior part of the succeeding vertebral bone. The sternal sutures are fine; that between the hyo- and hyposternal bone is transverse; while that between the latter and the post-abdominal is oblique, and at the margin quite squamosal. At that point the hyosternal underlaps the post-abdominal for a considerable distance, and the suture of the inferior side of the plastron, after bending forwards, is abruptly recurved, running along the edge of the posterior lobe.

The scutal sutures are not wide nor deeply impressed, but the abdomino-femoral, and the femoro-anal are distinct. The median, longitudinal, sternal, and the costo-marginal sutures are irregular and serpentine. The sculpture is rather fine, and consists of rather closely placed tubercles and ridges. The borders of the elements of both carapace and plastron are marked with ridges at right angles to the sutures, which are not short. The middle parts of the costal bones are marked by short interrupted or inosculating vermicular ridges closely placed. On the middle portions of the sternal bones the ridges are in places more broken, forming tubercles.

The surface of the bridge is angularly oblique to that of the plastron. The buttresses are not produced inwards. The free marginal bones are rather thin, and are not recurved.

Measurements.	M.
Length of a costal bone	.110
Width of the same	.032
Thickness "	.005
Length of hyposternal bone	.066
Width of the same at inguinal notch	.048
Thickness of the same in front	.007

Found by Superintendent Lucas with the foregoing species.

Sylviculture.

BY ELI K. PRICE.

(Read before the American Philosophical Society, November 16 *and December* 7, 1877.)

By the will of André Francois Michaux, the American Philosophical Society is, to the extent of the means afforded by his legacy, charged with the trust, to contribute in this country "to the extension and progress of agriculture, and more especially in Sylviculture in the United States." This Society, also, by its Charter is under the obligation of diffusing useful knowledge; and few subjects can be more useful than the cultivation of trees.

It becomes us, therefore, to consider how we can promote the cultivation of trees in this country; how make that cultivation subserve the interests of agriculture; and in what manner, and how widely we may fulfill these duties, and diffuse useful knowledge upon these subjects.

Mr. Michaux, as well as his father, spent his life in acquiring knowledge of trees, and wrote his volumes to describe them, not only to promote science, but to teach their uses and value as timber. He has intended that we should do more. He intended that we should promote the growth of trees, and also extend the growth of agriculture; by the influence of tree-culture upon climate, soil and the water supply, whereby to increase the food of man and beast, and thereby to multiply the population of the world.

In a revoked will he had suggested the purchase of land, and the planting of it with trees. In this he no doubt intended the exhibition of many varieties of kinds to give a scientific knowledge of them, and also intended that the groves there planted should be a centre of distribution of trees and their fruits. This idea has been held in view by this Society when it placed half the income of the legacy at the disposal of the Fairmount Park Commissioners, for the purchase, planting and distribution of trees and tree seeds. With half the income applied in this manner a more extensive good can be effected than by a separate application of the whole by the Society, which would of necessity have been at a more distant place, to be seen by a few only in the time that a thousand will see the trees in the Fairmount Park, and obtain their seeds. In that Park the name of the Testator has been honored by the plantings commenced in the "Michaux Grove," while thousands of trees procured by his provision are in the Nursery, waiting to be transplanted over the Park, of nearly three thousand acres, and elsewhere. These add to the variety of our plantings, and to the self sown trees of the native woods, thus adding increased attractions for botanists and lovers of the landscapes.

When Mr. Michaux extended his views to agriculture in connection with tree-culture, we must believe that he had in mind the influences of trees upon climate, the supply of rain and retention of water as means of growth of grass, the cereals and other crops. Let us consider then what are those influences, and how far, as beneficent, they are within the control of man; not that the means placed at our disposal by Mr. Michaux, can, in the trees they will plant, soon greatly influence climate, soil and rains; yet by affording a perpetual source of supply of trees, a perpetual example and diffusion of knowledge to others, no one can prescribe limits, in space or time, to the good these limited means may effect.

The Society will, therefore, I think, pardon me for taking a wide survey, for it and all others to fill in its outlined work, according to the measure of their ability, and in the aggregate, all may do a great good, that would not be attempted if the sphere of operation were not widely opened, and the necessity of co-operative action, and the ways and means of success, were not explained, to be kept in view at present, and in a long future. With our duty mapped out, we and our successors will see the surveyed field of operations, and will be stimulated by the grandeur and beneficence of the prospect opened for good to our fellow beings.

It cannot be doubted that Nature will ever willingly do her part of the work if not thwarted by man; nay, will do it exuberantly. The great need is to regulate and restrain his excess of destruction. Before man came upon the earth it had been densely covered by vegetation; hence its pervading coal measures, lignites, and stores of oil that have been preserved under the rocks to await the age of human intelligence necessary to develop them. In that age happily we live.

We may well believe that the earliest of our race found our world covered with forests; except in those places unfitted for their growth. These were the polar regions, where ice cuts off the growth of trees; the mountain crests where both cold and want of soil prevent all growth of trees, and arid deserts. Whether we may give trees to the deserts is only a question of procuring water and soil. Yet the seemingly barren lands cast up by the sea can be made to bear forests, and to flourish in vegetation.

Before man's appearance, the great enemies of forest life did not exist. He alone could invent the axe and light the fire. Forests were then in excess of man's needs, and were utilized in fossil coal. What evil he has done with the axe and fire, and how such evil may be repaired, we have to consider. True, the woods grow for legitimate uses; for timber, for habitations, the mechanic arts and fuel; but not for wasteful destruction. They must also be felled for needful space and soil to grow the food that man and beast may live; but not destroyed to an extent to put the supply of the food of life in peril; or to so lessen it as to lessen population. In regions covered with timber capable of tillage, in excess of that point which will support the largest population in prosperity, clearing, without waste of what can be utilized, becomes a duty; but to exceed that point is a wrong to humanity. In this we have the practical test that the wise and good will observe. Life to the greatest number of happy people is the moral and scientific problem and test of duty, as we must believe that such purpose was the intent of the Creator.

Taking in hand the light of History, let us pass over historic grounds to see what man has done to destroy the forests, and how and where he may prevent and remedy such devastations. Beginning at the supposed cradle of our race, we find in the books of the Bible and contemporary histories frequent mention of the presence of forests, the coverts of wild beasts, and accessible woods to answer instant requisitions for timber for building houses, bridges, towers and rams; of trees for shade and fruit, and fuel; and branches of trees upon which to hang malefactors. There were the cedars, firs, shittim wood, terebinth, sycamores, and oaks, upon mountains and plains, and the sacred groves upon the hills where the heathen worshiped, in a measure protected as sacred by religion and superstition; but in after time these were unavailing to save them. The fig, the date, the palm and the olive were better preserved, as necessities for food, and willows sprang spontaneous along the edges of the water.

Hesiod lived about a thousand years before Christ. Speaking of Peace, Justice and Prosperity, he says:

"No days of famine to the righteous fall,
But all is plenty, and delightful all;
Nature indulgent o'er their land is seen,
With oaks high towering are their mountains green;
With heavy mast their arms diffusive bow
While from their trunks rich streams of honey flow."

Thus described were they as seen, as he watched his flock and courted the Muses on Helicon. And again Hesiod describes a wooded country when he speaks of the north wind; says of it:

"Bellowing through Thrace, tears up the lofty woods,
Hardens the earth, and binds the rapid floods!
The mountain oak, high towering to the skies,
Torn from his roots across the valley lies;
Wide spreading ruin threatens all the shore,
Loud groans the earth, and all the forests roar."

The beasts;

"Through Woods, and through the shady vale they run
To various haunts, the pinching cold to shun:
Some to the thicket of the forest flock,
And some, for shelter, seek the hollow rock."

Evelyn cites with satisfaction that when Xerxes passed conqueror through Achaia, he would not suffer his army to violate a tree; "it being observed by the Ancients that the gods never permitted him to escape unpunished who injured groves."

Near five hundred years before Christ, Eschylus makes the Chorus sing to Prometheus Bound,

"Thy woes, beneath the sacred shade
Of Asia's pastured forests laid,
The chaste inhabitant bewails,
Thy groans re-echoing through his plaintive vales."

And nearly five hundred years after the Christian Era, Basil the Great writing to Gregory the Great, from the Isis that empties into the south side of the Black Sea, thus describes his home in that part of Asia Minor: "A high mountain clothed with thick woods, is watered to the north by fresh and ever flowing streams. At the foot lies an extended plain, rendered fruitful by the vapors with which it is moistened. The surrounding forest, crowded with trees of different kinds, encloses me as in a strong fortress." Humbolt's Cosmos, 393.

Herodotus had thus nine hundred years before described the country further to the East. "This part of Media, towards Saspires, is high and mountainous, and abounding with forests; the rest of the country is a spacious plain."

Of the north of Africa Herodotus says, "All the more western parts of Libya, are much more woody, and more infested with wild beasts, than that where the Libyan Nomades reside: for the abode of these latter advancing eastward, is low and sandy. From hence westward, where those inhabit who till the ground, it is mountainous, full of wood, &c." (Ch. 99; Sec. 191.)

Libya, or the region called Tripoli, extending from Egypt to Tunis, in the early Christian centuries while under Roman rule, was productive and populus, and when overrun by the followers of Mahomet, towards the end of the eighth century, was reputed to contain six millions of souls, and eighty-five Christian Bishops (Dr. F. L. Oswald), and now probably not a million inhabit the same space. Elesée Recluse says that "the examination of the soil and the remains which are contained in it, proves that at a recent geological epoch, the Sahara was much less sterile than it now is. The Tribes of the Algerian Sahara say, that at the time of the Romans the Ouad-Souf was a great river, but some one threw a spell upon it, and it disappeared. (The Earth, 95.) That spell was an evil one, the destruction of the forests.

Dr. Oswald says, "On the plateau of Sidi-Belbez, in the very centre of the Sahara, Champollion traced the course of former rivers and creeks by the depressions in the soil and the shape of the smooth-washed pebbles. He also found tree stumps almost petrified, and covered by a six foot stratum of burning sand." He quotes Champollion as saying, "And so the astounding truth dawns upon us that this desert may once have been a region of groves and fountains, and the abode of happy millions. Is there any crime against Nature which draws down a more terrible curse than that of stripping Mother Earth of her sylvan covering? The hand of *Man* has produced this desert, and I verily believe every other desert on the surface of this earth. Earth was Eden once, and our misery is the punishment of our sins against the world of plants. The burning sun of the desert is the angel with the flaming sword who stands between us and Paradise." How certain, how sad, is this great truth! How awful then to think of the millions more who might have lived but for man's ignorance, and folly and wickedness; and to reflect upon the incalculable loss of happiness to those who did live, and have struggled with a deteriorated Nature for a miserable existence!

According to Cæsar and Tacitus, middle Europe was found by the Romans heavily covered with forests, and in Gaul and Britain were the deeply shaded woods where the Druids had practiced their gloomy religious rites, and offered in sacrifice the victims of their terrible superstition.

Now pass from eastward of Persia westward, and take a survey of both sides of the Mediterranean as far as the Atlantic ocean, and we behold countries on every hand stripped of their forests, with decrease of rains, with fallen rivers, extended deserts, and depleted populations. This change from plenty to poverty is justly ascribed mainly to the destruction of the forests, which exposed the lands to a burning sun. The waters were dried up, and the soil was washed away by floods, or driven off by the winds, or covered over by ever drifting sands.

The following are the percentages of woodlands left in the once densely timbered countries of Europe where forests have not been adequately protected: Naples, 9.43; Sardinia, 12.29; Italy, 20.7; Spain, 5.52; Portugal, 4.40; France, 16.79; Belgium, 18.52; Holland, 7.10; Denmark, 5.50; Great Britain, 5; Switzerland, 15; while Germany yet has 26.½; Russia in Europe, 40; Sweden, 60; and Norway 66 per cent. of their surface in forests.

The lessons taught us by the other continents of the Eastern Hemisphere, are both to avoid the cause of aridity, and to repair in time the mischiefs caused by man's improvidence. We have in the west our "bad lands," our natural deserts, grassless and treeless, for want of water, and our grass covered prairies, also treeless, which can only be made productive of trees by the presence of water, and the absence of fires. Waters must be had by rains, or be drawn from the earth, or saved in reservoirs or tanks, to be spent in irrigation. We also have our exhausted lands on the Atlantic seaboard, which only need rest from tillage, and to be sown with the seeds and planted with forest trees.

What we can do for these may be seen by observing what has been begun to be done in other countries, not more favorably situated, where men have yet life and energy sufficing to repair ancestral delinquency. France has taken alarm and has begun the work of reparation. John Croumbie Brown has published a book of 351 pages entitled, "Reboisement in France," in which he describes the evils suffered, and the remedies of prevention and restoration. He shows the effect of stripping the mountains in east France of their trees has been to increase snow and land slides, which destroying that set in motion, also destroys that swept over in the descent, and that covered by the deposit. When the rains come, or the snows melt, the torrents come quick, are rapid and resistless. They undermine the banks, and carry destruction with them. Nature here again begins the work of restoration by scattering the seeds of the forest, and men have learned the wisdom of co-operating with Nature, and of letting her more alone. They now protect the forests, and the forests promote "infiltration, retention, and percolation of water through the soil and subsoil, on which they grow." p. 88, 50. In other Departments the like success has been attained as in the High Alps. Where the trees grow, the springs flow; where cut down the springs dry up, and the streams grow less in their channels. There is less rain fall, and the soil retains less of what falls.

On the west side of France from the Gironde to Bayone, are the *Landes*, or Sand-dunes, which are sands carried inland from the seashore by the winds, until they cover 2,500,000 acres, and threatened to engulf the departments of Landes and Gironde. These, however, have been planted with the pine and other trees, and the forests now protect the country behind them, and the sands have been considerably subdued by cultivation, and arrested in their inward progress.

In Algerian Africa the French Engineers, from 1856 to 1864, had dug eighty three wells, which together yielded nearly twelve millions of gallons of water per minute, sufficient to nourish 125,000 palm trees. (The Earth, by Elisée Reclus, 95); so that even the desert may be made to yield fountains of water, and can be clothed with arborial fruit and verdure; and it may be in this way that our treeless regions of the Far West can be attacked by American enterprise. Our warm south and south-west would, with supply of rain and irrigation, yield greatly increased quantities of semi-tropical fruit and forest trees of most valuable kinds.

It is the work of reparation of the wrong that man has done to Nature, and the prevention of the repetition of such wrong, that must now be the subject of our consideration, practical action, and admonition to others.

Let us first be sure that we are acting upon a true theory. There are those who think that forests have but little or no influence in producing or attracting rains; men whose opinions are entitled to great consideration and respect. Yet we well know that whenever the currents of air, laden with the moisture of evaporation, strike the cooler mountains, rain is precipitated. So woods, we may believe, may be so elevated and cool as to produce showers from clouds charged near to the point of precipitation, as the dew falls by a slight difference of temperature between day and night.

Men in the valley or plain often do see clouds pass over them to fall as rain on hills and woods more elevated. We know too that countries have less rain-fall by reason of the deprivation of their forests. Travelers so report of Malta, the Cape Verde Islands, St. Helena, and in Aragua, Venezuela, according to Humbolt; and in Egypt, where the date palm and the olive have of recent time been plentifully planted, the rains have become more frequent: (Dr. Franklin B. Hough's Report to Congress in 1874, p. 21). Dr. Oswald reports that a rise has taken place in Egypt in the annual rain-fall, from 9 to 16 inches, since the increased planting of trees.

It is quite certain that trees preserve the waters in the ground, and maintain the flow of the springs and streams. If trees be felled, and the sun be let in, the ground is dried, and its moisture is carried away by evaporation instead of percolating into the earth to reach the channels of the springs, and these also dry up. If the springs fail, the rivulets must fail, and rivers must fall.

Reclus says, "Trees, after they have received the water upon their foliage, let it trickle down drop by drop on the gradually softened earth, and thus facilitate the gentle permeation of the moisture into the substratum; another part of the water running down the trunk, and along the roots, at once finds its way to the lower strata." (The Earth, 223).

The facts are abundant in proof that to part with the trees is to lose the springs they protect, the running streams the springs supply, and the volume of the broad river. These lost, all the charm of the landscape has fled, and then this source of man's refinement and civilization has also left the world. With loss of rains and springs the fruitfulness of the earth also passes away. Grass fails for flock and herd, and the bread of life for man is no longer sure, and only because man has betrayed his trust.

Australia affords corroborative testimony. In the *Tribune* of December 1st, I find this statement: "Mr. Landsborough, an explorer of note, says, 'Keeping sheep is no longer so profitable there as it used to be, but on the other hand, large tracts of land that were worthless before, have latterly become fit for agriculture. There is a decided increase of forests and of moisture in parts of Australia, giving hope that eventually the whole interior desert may be reclaimed. The direct effect of sheep-raising has been to keep down the tall grass which formerly afforded material for destructive fires. The trees, young and old, had been periodically burnt by these fires, until the country becoming almost treeless, its climate had been rendered arid and its soil sterile. If the facts in Australia can be established, they will afford the most remarkable instance yet recorded of climate being modified by the labors and surroundings of civilized man.'"

Trees, better than all else, protect the slopes from washing into gullies, and the loss of the soil by rains. A carpet of grass will do much to protect the earth from washing; but is not impervious to the beatings of storms, and the small beginnings of erosions ever enlarge their channels by undermining the roots of grass. The sides of our hills and the sodded slopes of railroads show this. The force of the unintercepted drops of the driving rains does the work of excoriation. The leaves of the sheltering forest break the force of the rain, and the arrested waters trickle in slow drops to the ground, and gradually soak into it without washing the soil. The covering of the fallen leaves also prevents disturbance of the soil, and the leaves growing above, and those dead below as well, intercept the rays of the sun, and check evaporation. The retained waters must find their exit by the springs.

The forests in due proportion are also shelter and protection of the growing crops of the farmer from the force of driving storms. They are a shelter for grazing cattle, and shelter for house and barn, and man and beast thus kept warmer thrive better. Trees also shelter trees, and northwardly planted belts largely increase the growths of nurseries and orchards.

Now what is the due proportion of woodlands? A Duke of Burgundy's rule, as quoted by Dr. Oswald, is, "One-third to the hunter, two thirds to the husbandman." William Penn's direction to his colonists was, that "in clearing the ground care be taken to leave one acre of trees for every five acres cleared; especially to preserve oak and mulberry trees for silk and shipping." His father, Admiral Penn, would have included in it "shipping," for the purpose of maintaining a navy; still an object of our statesmen so far as iron has not superceded wood.

Thus William Penn's rule was to leave one for five acres cleared, or 16⅔ per cent. of wood appendant to each farm; of course, so much besides the wooded hills, sand-dunes and mountain tracts. For the entire country, and for the general good of forestry and agriculture his proportion of woodland is probably something too small. The proportion of woodlands in the entire area of these *States*, taking into consideration water surface, cities, highways, &c., is 29 per cent.; including Territories, is 25 per cent.; showing a disproportion of our Territories to be woodless.

Dr. Hough gives the rule of proportion of wood with reference to the true test. He says "There can be no doubt but that injuries may result, as well to agricultural interests as to the public, from an excess of forest growth. It is the highest aim of forestry to attain the golden mean between too much and too little, and on this due balance of field and grove depends that equilibrium of health and wealth that promises the greatest amount of human happiness to the greatest number, and through the longest period of time." Report, p. 32.

It is impracticable to bring the different States or sections of the United States to approximate any uniform standard as to the proper proportion of woodlands. It would generally be unprofitable to attempt to make arable, steep, stony and rough mountain lands, or poor sandy tracts, or deep swamps and ever-glades. But it is the interest of all to keep these wooded, and to reforest the lands worn out by cropping, that they may not become dry deserts. But every vast continuity of forest should be broken for agriculture, intercourse and security of health, property and life, and regions of prairie and deserts be made to bear a due proportion of forests.

And farm lands should be interspersed with trees to preserve them in the best agricultural condition. To do this, few farmers, though they draw their fuel from the mines, are inclined, by planting areas of cultivated or pastured fields. This they would not consider economical. But they could with little loss of useful space, plant the most sunny side of every road passing through their farms, and thus the farming soil would be little shaded, and the roots of the trees draw the greater part of their nourishment from the soil under the highway. The public would be gainers in grateful shade, and the farmers would have the protection of the roadside trees and their shade; and finally, their use as timber as they come to maturity, and are replaced by renewed plantings. To do so much, an enlightened self-interest should impel them.

In addition let every farmer keep open and flowing all his springs for drink for his herds and flocks; plant around them groves of trees, both to preserve the flow of the water, and to afford shade to man and beast.

Every railroad company should plant trees on the sunny side of their line of tracks for shade, and for cross-ties and car timber, against the time when lumber will surely become more scarce; and should, for its best self-interest, use every device to avoid firing the forests, and use cross-ties that have been barked, creosoted, kyanized, or saturated with boiling tar. The interest they have at stake to economize is incalculable.

Legislation is not here suggested, except it be to authorize the roadside planting; and, perhaps, counties to offer rewards for such planting. The functions of our Society in regard to tree planting are two: to diffuse useful knowledge, and to execute the trusts of the Michaux legacy, yet this is to co-operate in a sphere of action that is boundless and endless. True, our fund is small, but held by a perpetual trustee, its munificence should be perpetual; its beneficent effects never cease to spread, and the knowledge we impart and incentive we give, may bring sympathetic and enduring aid by many others, by the States, and the United States.

When we consider that trees require the growth of many years; that large tracts of country are denuded, which can be more profitably used by reforesting than otherwise, and that to make the reforesting useful and profitable, there must be choice of trees, and skill in the manner of their management and care, we must see that no time should be lost. This generation should begin the work effectively, and enjoin the duty upon those to follow.

The kinds of trees to be preferred by considerations of durability and their multifarious uses, are the American White Oak; the American White Pine; the American White Ash; the American Elm; the Chestnut, Walnut, Hickory and Larch. To this list of trees is to be added the Eucalyptus, or Blue Gum, of Australia, for its anti-malarial properties, and for its rapid growth, yet excellent timber. Its wood is white, about as hard, but a little stronger than the best Eastern Ash. (J. T. Stratton, Agl. Reps. of '75, p. 345). The planting and management must be left to professional skill.

The Massachusetts Society for Promoting Agriculture, who received two-fifths of the Michaux Estate, have offered prizes for the cultivation of plantations of not less than five acres, to be planted with the European Larch, Scotch and Corsican Pine, and American White Ash. The competition will be likely to exact the use of farm lands, while agricultural economy requires the chief sowing and planting of trees to be on the stony places, and profitless sandy spots, such as are often savingly allotted to bury the dead. These too may be planted with economy and pleasing effect.

Annexed to their circular is a very valuable Essay by Professor C. S. Sargent, Director of the Botanic Garden and Arboretum of Harvard University. This I have read since writing the preceding pages, and the facts and opinions by him expressed, sustain the foregoing views. He shows by sufficient testimony that woods do produce rainfalls; do preserve springs and rivers; do protect the soil and crops, nurseries and orchards; that sandy lands though exposed to the fierce winds of the seashore, have produced largely in Massachusetts, the Larch and Scotch Pine, besides Oaks, Ashes, Maples, Norway Spruce and Austrian and Corsican Pines. He recommends a protecting belt of trees to be planted on the northern side of every farm. The proper proportion of forest for Massachusetts he considers to be 25 per cent. Besides the woodlands in the State, there are nearly two millions of acres of unimproved lands, 1,200,000 acres of which is admirably suited for forest growth, the value of the timber on which, in fifty years, could only be reckoned by hundreds of millions. True, this would devote half the State to Sylviculture; yet, he thinks it would be its most profitable use, and be a benefit to that and other States.

Professor Sargent expresses his concern at the rapid destruction of timber in the United States, as sure to enhance its price, and produce many agricultural evils. He says, "Every year the destruction of the American forests threaten us with new dangers. Every year renders it more imperative to provide some measures to check the evils which our predecessors in their ignorance have left us as a legacy, with which to begin the second century of our Republic."

The Professor calculates so large a timber profit to his State, besides other advantages as to make it a moral duty, and patriotic achievement, to engage in tree planting, and insists that railroad corporations must plant in their own interest.

If farmers would generally plant one side the highways, and a row or belt of sheltering trees on the north side of their farms, and they and the Governments should see that all untillable grounds should be kept in the growth of timber as far as practicable, exempt from plunder and fires, we should attain that proportion of trees over the whole country which is required by the best interests of agriculture and the general good of the people. This should be the aim of all.

In Pennsylvania we have begun no considerable tree planting, except it be that in Fairmount Park. There, besides previous plantings, the Commissioners have planted within eighteen months, 12,082 trees, of the value of $14,490; and have yet in the Nursery 33,304 trees.

From the reserved moiety of the Michaux income, the American Philosophical Society has established in the Park the course of Lectures delivered by Dr. Rothrock on Arboriculture and Botany, who dwells emphatically upon the importance of woods for the preservation of water and soil and in protection of agriculture.

Citizens of Pennsylvania have, however, commenced an important Sylviculture in Eastern Virginia. Landreth & Co., of Philadelphia, have for six years and a half been planting 300 acres of black walnuts, and in a few years will complete some thousand acres in hard wood nut bearing trees. Mr. Burnet Landreth, a member of the firm, without fear of inciting rivalry, and without any apprehension that the growing market for timber can be overstocked, has published their doings in the *Journal of Forestry*, published in London. He seems actuated by the spirit of patriotism more than the love of profit. He laments that the White Pines of our State have gone, and those further north-west are rapidly going, leaving no succession in kind, and the Oaks and Hemlocks are fast departing, which are sometimes cut down to get the bark for the tanner. with but the contingent chance of selling the wood for cross ties and lumber. When felled both objects should certainly be secured.

Landreth & Co., buy worn-out lands cheaply ; buy them near navigable waters, for cheap transportation by water, sow or plant nuts of chestnut, walnut and hickory, or sow the seeds of the white pine, which they find to grow in the South, and leave the yellow pine seeds to sow themselves. They see a boundless area of timber growth before them and others ; trees of slow return ; but know that the market will await its maturity, and will be ever a rising one, as the country shall become more shorn of timber, denser in population, and more demand the consumption of timber. The profit awaited will be surely compensatory for capital, labor and interest thus invested ; and though for many years unproductive of annual income, the timber crop when it matures will be found to cover all the investment, with no interest of capital expended, but there self-invested by ligneous increment. It is an inheritance laid up for heirs ; a good to them ; a good to the nation. Yet the harvest is not all postponed, and to be but once, at distant period ; for the process may be one of successive thinnings of small trees thickly planted, and of old trees of different kinds maturing at different times, thus bringing repetitions of profits. The sowings of nature and the plantings of man may also be in every successive year, and different tracts thus yield annual returns as trees are fit to cut. The plantings should be annually repeated as the woods shall be thinned. It should be a rule, except in needed thinnings, never to cut down thrifty trees that are yet rapidly making wood. An economical instinct will teach all this to the provident forest proprietor. As certainly as the axe and portable saw mills cut up the best timber of the forest, as they surely are rapidly doing, the plantings of man, and the protected growths of nature, should follow with equal pace, with selections of kinds most profitable, except where cleared land is fit and required for agriculture. The whole country has but its 25 per cent., while there are excessive quantities in large tracts in some sections, and no forests in other vast areas. This shows another distribution of trees must be a work of the future.

Philadelphia should not overlook the interest she has in keeping well wooded the sources of the Schuylkill, the river that gives her chief supply of water. The Schuylkill Navigation Company began this beneficent work of supply of water and wooded protection by building their magnificent mountain reservoirs, and buying wooded tracts, by the shade of trees to protect the springs that supply them.

It will also be to the interest of the city to build, in the future, more mountain reservoirs. and protect their supply of trees, that she may have adequate stores of waters, there to meet the exigency of summer drouths, when her population shall have increased. The secured wooded water sheds, and the plantings in progress in Fairmount Park subserve the same purpose ; but with the city's growth her needs will increase of conserving her water supply at a distance, that our second beautiful river may continue adequate to the wants of a metropolis of millions.

Here should be specially brought to notice, the necessity of a vast amount of tree planting in the prairies and plains that extend over the central length and breadth of our northern continent. With great depths of alluvial soil, protected by the heavy prairie grasses, which through the centuries have annually added their decaying richness to the vegetable mould, the rolling or flat prairie regions have but occasional groups of trees. The cause of the absence of trees seems to have been the frequent fires that swept over the prairies, for wherever protected by the settlers from fire a thick and flourishing growth of trees springs up, and the plantings also thrive.

The prairies need trees the more, to induce precipitation of rain, and to protect the soil, springs and streams from evaporation, by reason of the immense extent of wheat and corn crops now grown in continuous fields of a thousand or more acres, each spring sown or planted, thus exposing the bare ground for more than half the year, in the intervals of the crops, to the drying sun, to be swept away alike by winds and rains. And heavy belts of growing timber are wanted for more than the attraction and retention of rain and water ; are wanted to make it something more possible to arrest the great prairie fires ; and also, to break the force of the storms and tornadoes that so destructively sweep the central parts of our continent ; where no sheltering mountains or hills exist to arrest the force, and disperse the winds. Some such benefit has already been perceived and acknowledged.

In the prairie and treeless regions of the central West, where settled, the settlers have perceived it to be their interest to plant, and to save the spontaneous growths of trees, and beyond the incentive of interest, the pleasurable occupation has kindled an enthusiasm for Arboriculture. The fires are fought, and less frequently lighted ; coal, when at hand, is preferably used for fuel, and the spontaneous second growth is generally better than the original forests where these had been. In the State of Minnesota, Martin County, "thousands of acres of young timber trees are growing, some spontaneous, others planted ;" in Redwood, "The cultivation of forests on the prairies will amount to from 1 to 20 acres per quarter section ;" in Steele County, "Some attention has been given to planting forest trees, and the interest is on the increase, as the experiments have been quite successful ; many small groves of quick growing varieties being planted near dwellings ;" in Watonwan, 1,000 acres are under cultivation, in groves of from one to 12 acres ; in Nobles County, "An association has been organized, and the children in each school are being organized into Centennial bands of little foresters, with promises of badges and more valuable prizes for planting trees." In the State of Iowa, Crawford County, "Large numbers of the more thrifty farmers have planted groves of maples, cotton wood, black walnut and box elder, which have grown with great rapidity, and the vast expanse of treeless prairies, which a few years ago stretched in every direction as far as the eye could see, is now dotted over with beautiful groves, which greatly add to the wealth of the county," and in Cherokee County it is reported, "A great many are planting timber, which grows fast." For Missouri it is reported that, "In the portions of the State that were originally prairie land or openings, spontaneous and thrifty forests have sprung up and increased, as increasing settlements have prevented annual prairie fires;" for the County of Greene it is stated, "Nearly all the old timber is inferior, for the reason that the woodlands produce abundant grass, which is burned over every season, and injures the trunks of the trees. Forests, from which the fires are kept are very thrifty, many of the trees adding one inch to their diameter annually." See Agl. Rep. for 1875.

For Kansas and Nebraska, the Report of 1875, says, "On original prairies, forest growth is increasing rapidly from two causes: The first is, the arrest of prairie fires by cultivation, which has resulted extensively in the spontaneous springing up on uncultivated portions of a thick growth of young trees, which grow with wonderful thrift; the second cause being the planting of forests, now doubly stimulated by legislative encouragement, and by assured success in respect to both growth and profit. In addition to personal advantages to the planter, in the increased comfort, beauty, and money value of his premises, it is claimed that a public benefit is already perceptible in a modification of the climate, particularly in the way of assuaging the severity of the once unimpeded winds." Of Jefferson County, Kansas, it is said, "The forest area is rapidly increasing in consequence of stopping the prairie fires, and the planting of new groves;" while of Barton County, it is said, "Flattering results have been obtained from planting tree seeds and cuttings."

Tree planting in California is receiving much attention. Before the 1st January, 1876, James T. Stratton had planted in Alameda County, 195 acres with 130,000 Eucalyptus trees, that is the Blue Gum of Australia, eight feet apart each way. The company owning the railroad between Los Angelos and Anaheim, in Southern California, had planted 140 acres, with about 80,000 Eucalyptus trees. In the spring of this year it was announced that, "The Central Pacific Railroad Company has lately arranged to have 40,000 *Eucalyptus Globulus* trees set along the 500 miles of the right of way of the company. This is only the first installment, as it will require about 800,000 of the trees for the 500 miles of valley where they are to be cultivated. The immediate object of the plan is to increase the humidity of the region, and lesson the liability to droughts."

The United States Government has begun to take a deep interest in the subject of the preservation of American Forests. This appears to have had inception in a Memorial to Congress of the American Association for the Advancement of Science, upon the cultivation of timber and the preservation of forests, in August 1873, signed by Franklin B. Hough and George B. Emerson their Committee, which being referred to the Committee of the House on Public Lands, Dr. Hough, on March 10th, 1874, submitted to Washington Townsend, Chairman of that Committee, his views at length on the subject of the Memorial. These were printed by order of the House, in a Report of 118 pages. It is a full, yet compact statement of many facts and statistics, which abundantly sustain the conclusions herein expressed. There followed in October 1875, the Report of the Commissioner of Agriculture for that year, a division under the head "Statistics of Forestry," from p. 244 to 358, giving the forest area of every county in every State in the Union, in number of acres, and the percentage of the whole number in the County and State, with other valuable information. It is very important in its promise of future reports, and also from the fact that will be the basis of contrast, to show the progress of reforesting the country. An Act of Congress of August 15th, 1876, gives earnest that Congress will guard this great national interest, especially as it made an appropriation for the compensation of a competent commissioner to investigate and report upon the preservation of the forests, and the exportation of timber and other products of the forests. I have an answer to my inquiry, from Dr. Hough, the Commissioner, saying that he is at Washington to print his report in that of the Commissioner of Agriculture; that he has tried to do justice to Michaux and others; thinks the facts he has collected opportune, and that the interest in forestry is growing. The President's Message to Congress of this month earnestly recommends legislation to protect the timber belonging to the Government, and the preservation of the forests of our country.

The proposition before us invokes physical causes for physical effects. Yet are these very interesting to our mind and feelings. They concern deeply human life and happiness. The mind must plan and execute the work; must appreciate the beneficent results, and not without gratified emotions in view of the good to come. The purposed means will seek to influence the elements; in a measure to rule the powers of the air; to draw rains from the clouds; to detain the waters in the earth to flush the springs and swell the streams; will both drain the marshes, and cause wells and fountains to flow in the desert; cause the grasses and cereals to cover the fields, and the forests and woods and trees to grow on mountains, hills and plains. Yet all this, is not to speak or act presumptuously, for it is but to use the powers placed at man's disposal. It is to do more extensively what has been done; what is therefore practicable. Man is to engineer, to plow and plant, and sow and water, but God must give the increase. Man is to obey the first command, "Replenish the earth and subdue it." Obedient to this we have the promise, "I will give you rain in due season, and the land shall yield her increase, and the trees of the field shall yield their fruit."

That the evils reviewed have been terribly aggravated during many centuries, should not discourage us. The full remedy may require as many centuries as the cause has been operative; but every step of repair is beneficent progress. The world is now fuller of resources than ever before. Man's enginery is gigantic; his machinery is imbued with intelligence.

He can destroy faster; but knows how to repair his injuries sooner. But to cease to do evil is to begin to do good; for Nature only asks man's leave to renew her beneficent growths. Stop the fires on the prairies, lighted by the hunter for unknown centuries, and Nature will clothe them with forests. Plant with trees, and protect the self sown seeds of the forests along the waste lands of the seaboard, and they are born who may see them all reforested; see them also renew a virgin forest soil. We have just begun many beginnings. Let them be followed up by many zealous co-operators, and our country will exhibit a prosperity, salubrity, and beauty never before seen, and in due time will become the dwelling-place of millions more human souls, else not to be born; souls to be happy on earth, and to people heaven. If this world was worth the making it must be man's duty to make it teem with happy life.

ADDENDA.—Since reading the above paper, Prof. Lesley has kindly sent me two quotations which strongly support the views and purposes of the essay read. E. K. P.

I. "The country from the head of St. Croix river [in Wisconsin] to Bayfield is covered with drift. . . . not an outcrop for fifty miles. Most of the district is destitute of living springs and streams. Numerous depressions in the drift are partly filled with water . . . . . The soil is sandy and barren, supporting only a stunted growth of 'jack' pines and 'scrub oaks.' Fire has killed the timber over wide areas, on which grass was growing, exhibiting before our eyes nature's simple method of converting woodland into prairie. The reverse process is just as simple. When prairies are no longer swept over by fire, timber springs up, re-converting prairie into woodland. Grass, with fire as an ally, can beat timber. Timber can beat grass when it has no fire to fight."—Report of O. W Wight in Geology of Wisconsin, p. 76, 1877.

II. "In the whole Kingdom of King Devánámpriya Priyadarsín, as also in the adjacent countries; . . . . the Kingdom of Antiochus, the Grecian King and his neighbor Kings, the system of caring for the sick, both men and cattle, followed by King D. P. has been everywhere brought into practice. Wherever useful healing herbs for man and beast failed, these he introduced and cultivated. Wherever roots and fruits were wanting, these he introduced and cultivated. He caused also wells to be dug and trees to be planted on the roads for the benefit of cattle."—Dr. Kern's translation of the Girnâr rock inscription in India, second section of the tablet. See p. 193 and Plate 1. Jour. R. Asiat. S. Vol. IX. part 2. July, 1877.

What Christian nation has provided so humanely for traveling man and beast? The purpose of trees and shade as above advocated is immediately practicable and beneficent. Let us also open the roadside springs and wells, and furnish the cup for cold water; and maintain the supply of medicinal herbs, roots and barks. This we will begin in the Park as soon as the Pharmaceutists will lend their efficient co-operation. Except in the hospitals of our large cities, and county poorhouses, the sick wayfarer must depend upon humane tavern landlords and benevolent citizens, who seldom fail in Christian charity. But may God and man save us from *Tramps*.

Causes of the Huron Disaster.

By Prof. Wm. Blasius.

(*Read before the American Philosophical Society, December* 7, 1877.)

The whole country mourns for the appalling and terrible disaster that befel the United States war-vessel "Huron" with her hundred brave mariners in the recent storm on our coast. It is not the rareness of such terrible calamities that causes this surprising and deeply felt sympathy with the brave and gallant men who found here so unexpectedly and untimely their watery grave. The Public Ledger of Philadelphia, only a short time ago enumerated 44 vessels belonging to, or bound to, or from American ports only that shared during the short period of one single month a similar fate. Unfortunately such calamities are not seldom on our shore, and they indeed follow each other so rapidly in succession that the last one only obliterates the still vivid traces of the preceding one. Thus they are forgotten one by one, and their stories are only revived for moments, when commerce and pleasure seekers apply to the Government for the removal of the wrecks that are in the way of their pursuits.

What makes, however, this case so particularly impressive in the minds of all men is, that the Huron was a war-vessel, recently built, supposed to be well fitted and found, staunch and speedy, that it was commanded by naval officers who are looked upon as particularly skilled navigators, and understand how to fight the storm as well as the foe, and to whom the nature of the depth in these friendly waters ought to have been as familiar as their staterooms. We cannot wonder then that the public anxiously inquires into this dreadful and mysterious disaster, and tries to unravel its cause.

Neither is it strange in these corrupt conditions of society that some find it in the defective construction of the vessel; some lay the blame on the commander for having started at sea when the warning signals were flying, and for hugging the coast too closely in order to gain time. Some wise old captains of merchantmen lament the loss of good old practical seamanship; they hint "that the naval officer proper need now be but an indifferent kind of a sailor, so long as he is a good mathematician, chemist or drill-master, appears well, dresses tastefully in well-fitting uniform according to the latest edicts of the naval Turveydrops, and has possessed himself of a diploma issued by the United States Naval Academy." There may be some truth in these suggestions, but it is not likely.

From the meagre facts hitherto published, it will of course be useless to argue any of these surmises; but as the Government doubtless will probe this matter to the bottom for the sake of preventing future similar accidents, I would respectfully draw its attention to a third potent agent which seems to have been completely overlooked by these wise critics, and which probably had more to do with this fearful disaster than the strength of the vessel or the lack of so called seamanship, and this third agent is the general and lamentable want of a knowledge of the true nature of a storm.

The statements made to the reporter of the New York Herald by Rear Admiral Trenchard, commanding the North Atlantic Station, on board the flagship Powhatan, lying off Fortress Monroe, seems to throw the first two supposed causes almost out of the question. He says: "That on Thursday the vessel was thoroughly inspected by him and his staff, and found to be in first-class order," as only would be expected from a first-class lately built war-vessel. "Captain Ryan," he says, "was a careful and experienced seaman, had surveyed the coast along which he was to pass, and was considered one of the best navigators in the service;" this settles, it seems to me, these two points above all suspicion.

As to the third agent, the storm, which by the general critic has been overlooked, but which the Admiral takes also into consideration, he says: "He sailed at eleven o'clock in the morning, at which time the barometer was not indicating bad weather; was rather above, as shown by the official log." And the surviving officer, Master W. P. Conway, gives us the following information: "At 8 P. M. there was a strong gale blowing, and the sea was running very high. The barometer stood at 30.04 for three hours. The jib-stay was carried away soon after 6 P. M."

The last statements of Admiral Trenchard and Master Conway have reference to the storm and the theories about it, and furnish the key to unravel the cause of this mysterious and sad tragedy. The barometer, the only guide science hitherto has furnished the navigator for his safety was conscientiously consulted; it stood "rather above" the mean, and therefore "did not indicate bad weather."

Captain Ryan, who unfortunately cannot speak any more for his own justification, but who was considered "one of the best navigators in the service, and a careful and experienced seaman," had undoubtedly looked also to this same guide for advice before he started, and finding of course the same answer, was certainly justified in view of the present state of science and good seamanship to start on his voyage in spite of the warning signals flying, the more so as according to the papers these signals had been flying for weeks uselessly and had become, therefore, disregarded generally by seamen. From his high position and reputation, and the testimony Admiral Trenchard bears him, we can neither doubt for one moment that he was fully acquainted with the science of storms and the rules of navigation based on it, and that he had studied the writings of Capper, Thom, Piddington, Reid, Redfield, Dove and others whose views are adopted officially in all navies. The accusation of bad seamanship seems, therefore, unfounded, unjust and cruel, because all these celebrated men of science up to the present time teach, that the storm consists in an area of low pressure, *i. e.*, an area where the barometer stands below 30 inches, and that the navigator, therefore, has to expect a storm or a so called cyclone only when the barometer falls below this mean, but when the barometer stands above he may look for fine and clear weather from the approach of an area of high barometer or an anti-cyclone. Captain Ryan was, therefore, justified in starting to sea in accordance with the present navigation rules deduced from the generally accepted theory.

In my work, "Storms, their Nature, Classification and Laws" (published two years ago), I think I have demonstrated that this old theory is wrong and worse than useless, that it is illusive and mischievous, and leads often into danger instead of out of it. I showed that the area of low pressure or low barometer is not the storm, but only the effect of the storm, and that the progressive storms (the equatorial and polar storms) of the temperate zone, with which we have principally to deal, consist of two areas of high barometer or rather of two ærial currents of different direction and temperature, which, so to speak, create the area of low barometer between them, by the obliquely upward flowing of the warmer current over the face of the colder. Whether the storm, *i. e.*, this system of two opposing currents of different temperature which displace each other, comes over us with falling or rising barometer depends entirely upon the kind of storm, the state of its development and the position we are in towards these three parts of the storm, facts about which the clouds and the direction of the wind give trustworthy information. The barometer is, therefore, unreliable.

To illustrate this important matter I showed that the heaviest rains and most destructive storms had passed for two days during their earlier development in the form of high pressure through the jurisdiction of the Signal Service Bureau without being recognized as storms, until arriving at the coast—as for instance, the Nova Scotia storm, 1873—they destroyed over a thousand vessels and six hundred lives in almost a single night.

The fact that the barometer stood above the mean height is, therefore, an explanation of why the Huron sailed notwithstanding the Signal Service warnings, but why should she hug the coast? In the absence of the commander the most that can be offered is a plausible conjecture, but it seems probable that his action in this respect was in the belief that this was the safest course for him to take, a belief founded on the rules issued by the Navy Department for maneuvering in such cases.

These "Nautical Rules" instruct the navigator that in storms or cyclones the "manageable semicircle" is on the left side of the path of the centre, *i. e.*, in storms traveling up the Atlantic coast the "manageable semicircle" is on the coast side of the storm, and the "dangerous semicircle" out at sea. And therefore, according to these rules issued for his instruction and guidance, Commander Ryan did perfectly right to keep to the coast so as to be in the "manageable semicircle" of the cyclone. He had to select between two evils—the "dangerous semicircle" and the coast. Had he gone out to sea he would have come in the "dangerous semicircle" and disobeyed these published rules of his department, although as the sequel shows he would have saved himself, crew and ship. These "Nautical Rules" are founded on the dicta of the most eminent meteorological authorities, and strictly in accordance with the science as it now stands, but when several years ago I asked the accomplished Chief of the Hydrographic Office, Bureau of Navigation, how many vessels he supposed they had saved, he responded: "Not many, I think." It gives me pleasure to state that the same gentleman has lately recommended my work for use in the Navy, saying, "that his experience bears it out."

The fate of the Huron is but another of the many victims to the Moloch of erroneous meteorological theory ; it is too much to hope that it will be the last one, but let us trust that such terrible events will grow less and less frequent until the time comes when there may be none fairly chargeable to a lack of a knowledge of the true nature of storms.

Bituminous Material from Pulaski County, Virginia, U. S.

By Dr. Charles M. Cresson.

(*Read before the American Philosophical Society, October* 19, 1877.)

The locality from which the sample was taken, is four and a half miles north of the Atlantic, Mississippi and Ohio Railroad property of W. T. Hart, said to be from a vein averaging 32 feet in thickness. Dip variable from 30° to 50° ; is covered by 2 feet of fire clay. Footwall, soft gray slate. Sample from 45 feet below water level.

Results of laboratory examination as follows :

Color	Black.
Streak	Brown.
Structure	Lamellar and Friable.
Specific Gravity,	1.566.
Moisture and Volatile Matter	7.50 per cent.
Fixed Carbon	65.52 "
Ash	26.98 "

There was no clinker got in the laboratory experiments, although the ash was subjected to a high degree of heat.

Sulphur	0.165 per cent.

One pound of material burned in Oxygen evaporated 10.12 pounds of water from 212° Fahrenheit.

After deducting the average losses, by heat absorbed by ash, products of combustion and radiation, there remains as the result of the combustion of one pound of fuel, 7.59 pounds of water evaporated, or about the same amount as is evaporated by burning one pound of the best coke from bituminous coals.

Experimental trials made in locomotive and stationary tubular boilers, with samples supposed to represent an average of the vein, produced somewhat different results from those obtained from the selected samples sent to the Laboratory for analysis. Upon the large scale, this fuel gave at first an exceeding hot and lively fire, but as soon as the bituminous matter was burned off, the fire became dull and required stirring. When the draft was insufficient to carry oft the ash, there was gradually formed a spongy, lava-like cinder, which it was necessary to remove in order to obtain sufficient draft. It therefore appears, that although samples of this fuel can be selected which will give favorable results upon the small scale, the mass of the vein can hardly be used for the general purposes to which anthracite is applicable, and that it requires some especial device for the removal of the voluminous ash, to enable the successful and coutinuous use of the fuel for ordinary purposes.

CONTRIBUTIONS FROM THE LABORATORY OF THE UNIVERSITY OF PENNSYLVANIA.

No. XII.

A new method for the Decomposition of Chromic Iron. By Edgar F. Smith, Ph. D., Assistant in Analytical Chemistry, University of Pennsylvania.

(*Read before the American Philosophical Society, December* 21, 1877.)

Recently I was led to try the action of bromine and sodium hydrate upon pulverized chromic iron, and as the amount of chromium extracted in this manner was rather surprising, the following experiments were made, to ascertain what effect bromine alone in presence of water would have upon the same substance.

I. Moderately fine chromic iron (.1500 Grm.) was placed in a tube of hard glass, and after adding dilute bromine water and sealing the tube, the latter was placed in an air-bath and heated for twelve hours at a temperature of about 130° C.; when cool the tube was opened and its contents poured upon a filter. The insoluble residue was thoroughly washed by decantation, and upon the filter, with hot water. The filtrate after concentration was treated with a slight excess of ammonium hydrate, causing the precipitation of aluminum hydrate, &c. The latter was filtered off and the yellow colored filtrate, then warmed with hydrogen sulphide to reduce the chromic acid to oxide. The precipitate formed, after protracted digestion, was allowed to settle and the clear liquid filtered. After washing the precipitate it was dissolved in a few drops of dilute hydrochloric acid and re-precipitated. This operation was repeated and the precipitate finally transferred to a filter washed, dried and ignited. The amount of chromium oxide found corresponded to 15.50 per cent, of the substance taken.

The amount of chromium remaining in the material not attacked by the bromine was not estimated.

II. .2000 grms, substance, as finely pulverized as could be obtained by grinding the material in an agate mortar, were heated in a sealed tube with water saturated with bromine and a few drops of bromine. The tube was allowed to remain in the oven for four days, the temperature ranging from 175° - 190° C. Upon opening the tube its contents were poured into a beaker and evaporated; water then added and the solution filtered. The residual, unattacked mineral powder after washing, drying and igniting, weighed .0820 grms. The filtrate from this was treated precisely as in (I) and the chromium oxide obtained from it amounted to 28.05 per cent.

III. In this experiment only .1500 grms. substance were employed. The material was of the same fineness as in (II). Instead of using dilute bromine water as heretofore, an excess of bromine was poured over the substance and but a very small quantity of water added. For three days the tube was exposed to a temperature varying from 150° – 175° C. At the expiration of this time the tube was examined, and as the substance appeared to be perfectly decomposed, the solution was removed from the tube and evaporated in a beaker glass to expel the large excess of bromine, upon the gradually disappearance of which a dark powder showed itself. The solution was strongly diluted with water and filtered. The insoluble residue was thoroughly washed with hot water. Dried and ignited, this weighed .0140 grms.

The filtrate was mixed with an excess of ammonium hydrate and evaporated almost to dryness in a casserole. The solution was then diluted with water and filtered from the aluminum hydrate, &c., and treated as in (I). The percentage of chromium oxide extracted equaled 49.60 per cent.

IV. From the preceding experiments it appeared very evident, that all that was lacking to render the decomposition complete was to have the chromic iron in an exceedingly fine condition. To this end the material that had been ground to an impalpable powder in an agate mortar was elutriated, then dried, and two separate portions of .1500 grms. each placed in good, hard glass tubes. To each portion was added a rather large quantity of bromine water and from 10–12 drops of bromine. Both tubes were heated for one day at 130° C. For two successive days the temperature was maintained at 170° C. At the expiration of the third day, one of the tubes was removed from the oven and opened. Red oxide of iron had separated and undecomposed material was no longer visible. The whole was poured into a beaker and evaporated; water added and filtered. The residue was thoroughly washed, dried and ignited, then transferred to a beaker glass and heated with dilute hydrochloric acid. The entire mass dissolved readily and without a residue. The decomposition was, therefore, complete.

The filtrate from the ferric oxide was evaporated almost to dryness after the addition of an excess of ammonium hydrate, then diluted and filtered. The solution was reduced with hydrogen sulphide and the precipitate, after filtering and washing, dissolved in dilute hydrochloric acid and re-precipitated with ammonium hydrate. This operation was repeated and the chromium oxide obtained was 62.66%.

The second tube which was removed not long after the first, contained a large amount of separated ferric oxide. This, after filtering off the chromium solution, also dissolved very readily in warm, dilute hydrochloric acid, leaving not the least trace of residue.

The filtrate from this, after being similarly treated as above, yielded 62.83 per cent. chromium oxide.

These results accord with those of Garrett, who analyzed the same ore from Texas, Pa., and obtained about 63. per cent. of chromium oxide.

The ferric oxide that separates out in the tube during the decomposition will not contain any chromium whatever, if it is thoroughly washed with boiling water.

In no instance was iron found in the solution containing the chromic acid.

Several tubes containing the pulverized substance, potassium hydrate and bromine water, were heated at 125° C., but invariably exploded before the decomposition was completed, and therefore no further attempts were made to use the alkali to aid in the decomposition.

All that is necessary to effect the complete decomposition of chromic iron by this method is that the substance be exceedingly fine, and that the same be exposed with bromine water to a temperature of 180° C., from two to three days. The addition of 10-12 drops of bromine hastens the decomposition very decidedly.

In connection with the above, it may be well to mention that the insoluble chromium oxide obtained by the ignition of the corresponding hydrate, may be brought into solution again by digesting it together with bromine and sodium hydrate in a beaker.

Precipitation of Copper with Sodium Carbonate.

The precipitation of copper from its solutions by sodium hydrate, gives a precipitate that is worked with difficulty. Sodium carbonate, on the other hand, added to similar solutions, and these boiled, affords a dark brown, granular precipitate, that may be readily and completely washed with hot water.

Mr. Harry G. McCarter, student in the Laboratory of the University, made the following analyses, which show that the method yields as accurate results as could be desired.

I. .2000 grms. $CuSO_4 + 5H_2O$ —dissolved in water and precipitated with sodium carbonate, gave .0630 grm., $CuO = 25.15$ per cent Cu.

II. .2000 grms. $Cu\,SO_4 + 5H_2O$ —treated as above, gave .0634 grm. $CuO =$ 25.30 per cent Cu.

The theoretical percentage of copper in the salt is 25.25 per cent.

After the addition of sodium carbonate in slight excess to the copper salt solution, the latter was boiled for an hour, until all the carbon dioxide was expelled.

The filtrates from the precipitates in every instance were evaporated, but not the slightest trace of copper discovered.

An excess of acid in the solution from which it is desired to precipitate copper by an alkaline carbonate, should be avoided.

The presence of rather large quantities of alkaline nitrates or sulphates will cause the solution of the precipitates first produced by the carbonates. Continued boiling will not remedy the matter. From such solutions, however, the alkaline hydrates will not fail to precipitate the copper.

Descriptions of New Vertebrata from the Upper Tertiary Formations of the West.

By E. D. Cope.

(*Read before the American Philosophical Society, December* 21, 1877.)

PITHECISTES BREVIFACIES gen. et spec. nov.

Char. gen. These are chiefly known from a mandible which supports the dentition of one side and part of the other. The dental formula is I. 1; C. 1; Pm. 3; M. 3. The single incisor of each side is weak and easily lost, and there is on one side only, a small alveolus for a minute second incisor. It is therefore probable that in some individuals the incisive formula is 2. The canine is not large, and closes in front of the superior canine in the usual manner. The first and second premolars are one-rooted, and their crowns are wider than long. That of the third premolar is robust, but longer. The molars increase rapidly in size, and are not prismatic, but are well rooted. They are worn in the specimen, but their structure is probably shallow selenodont. The last molar has a long heel or fifth lobe.

Char. specif. The mandibular ramus is very deep posteriorly, and the incisive border is not prominent. The canine tooth is quite small, its transverse diameter being less than that of the first premolar, and equaling it antero-posteriorly. The exterior incisor is weak, and the crown expanded transversely, and obtuse. The crown of the first premolar is worn deeply by the superior canine. The transverse diameter at the base of the crown exceeds the antero-posterior. The crown of the second is wider than long, and of the third longer than wide. The molars increase rapidly in size posteriorly, so that the length of the third equals that of the three premolars plus the canine. The heel is long, and is connected with the remainder of the crown by a narrow plate, or in section, an isthmus. There are no cingula, but an accumulation at the bases of some of the teeth resembles the deposit of "tartar." The symplysis is very robust, and its upper surface is marked on each side by a low longitudinal swelling. The opposite premolar series are slightly convergent.

The form of the mandible of this animal, as well as the number and proportions of the teeth, curiously resemble that of the corresponding part of a monkey. The species was about the size of a red fox.

Measurements.	M.
Length of ramus from heel of molar III	.057
" molar series	.048
" premolar series	.015
" second true molar	.010
Width " "	.007
Length of last molar	.018
Width of " at front	.007
Length of symphysis in front	.020
Depth of ramus at first premolar	.017
" " second true molar	.025

BRACHYMERYX FELICEPS gen. et sp. nov.

Char. gen. These are derived from the superior dental series. These are I.^{2}; C.^{1}; Pm.^{3}; M.^{3}. The true molars have the bases of the crowns little swollen, and the last two of the superior series are but shortly rooted; the anterior ones have longer roots. The true molars are simply selenodont, with the anterior extremities of the external crescents forming prominent ribs. The last superior premolar consists of two columns posteriorly and a single trenchant one anteriorly, and the second (first of the series,) is simple and trenchant. The worn posterior face of the canine shows that the first inferior premolar is the functional canine as in *Oreodon*. There is a very slight diastema in front of or behind the canine, the series being continuous, as in *Oreodon*.

This genus differs from *Pithecistes* in its canine like first inferior premolar, and in the trenchant character of the anterior premolars. With *Cyclopidius* it enters the family group of the *Oreodontidæ*, but approaches the suilline types still more nearly in its probably coössified symphysis mandibuli.

Char. specif. This ungulate was a little smaller than the species last described, and is represented in my collections by two nearly complete crania without mandibles. The head is depressed and the zygomata widely expanded; the palate is wide, and the muzzle short. The infraorbital foramen is double and issues above the adjacent parts of the second and third (last) premolars. Immediately in front of it the side of the face is concave.

The projecting anterior angles of the external crescents of the molars are very prominent, forming strong vertical ribs. The external border of the last premolar is only interrupted by a little convexity. The anterior narrow portion of the second premolar is incurved. This tooth is two-rooted; the first is one-rooted. The canine is small and strongly recurved. It is cylindric at the base, but beyond this is narrowed antero-posteriorly partially from the friction of the first inferior premolar. The anterior face is regularly convex. The first premolar has a very slight internal basal cingulum; its cutting edge is directed obliquely to the long axis of the cranium. There are no cingula on the other teeth. The enamel of the true molars is smooth on the external side of the crown. There is no enamel on the inner walls of the central lakes.

Measurements.	M.
Length of dental series to anterior border of canine	.050
" premolar series	.017
" last true molar	.012
Width of " "	.006
Length of first true molar	.007
Width of " "	.006
Length of first premolar	.006
Width of " "	.006
Length of canine tooth	.009

Measurements.	M.
Diameter of canine tooth (transverse)	.004
Width of cranium between first premolars	.016
" " " last molars	.030

The cranium of this species is about the size of that of a large domestic cat.

CYCLOPIDIUS SIMUS. Gen. et. sp. nov.

Char. gen. Dental formula I. $\frac{2}{2}$; C. $\frac{1}{1}$; Pm. $\frac{4}{4}$; M. $\frac{3}{3}$. The superior canine is small and is separated from the first premolar by a very short diastema. First premolar simple, trenchant; second premolar two rooted, with one principal cutting edge; third with an external crescent and a rudimental internal one, not united in front. Fourth premolar with the inner and outer crescents only, and these well developed. Last true molar without heel. Inferior canine with much wider crown than the incisors with which it is in close association. First premolar canine-like, but not very large; second premolar simple. Third and fourth premolar with the anterior portions trenchant, the posterior with wide or double columns. Last true molar with large fifth crescent or column. True molars of both jaws prismatic. Symphysis mandibuli coössified.

Frontal bones much abbreviated in front by a large upwards-looking fossa on each side, which are separated by the very narrow and short nasal bones. There are lachrymal fossæ and a huge foramen in front of them, which communicate with the maxillary sinus. There is a prominent transverse supraoccipital crest, and the otic bullæ are greatly inflated.

This genus is related to *Leptauchenia*, Leidy, but differs in having but two lower incisors below. That genus belongs to a lower horizon, the miocene of White River, while the present form is its successor in the upper Miocene or Loup Fork beds. The remarkable character of the vacuities in the superior region of the front part of the cranium, reminds one of the existing genus *Sæga*. Dr. Leidy partially described a similar structure in *Leptauchenia*. In this genus what are clearly nasal bones in *Cyclopidius*, he terms frontals, probably by error.

Char. Specif. This animal is rather larger than either of those above described, and is represented in my collection by one nearly complete cranium, one entire left maxillary bone, and the under jaws of five, and probably of several other individuals.

The skull is wide and abbreviated in front. The maxillary bones are everted on each side of the external nares. The malar bone is very wide or deep, and sends upwards a strong postorbital process, which is broken off in part, but which probably completed the orbit. The superior facial fossæ reach backwards nearly as far as the middle of the orbit. They are longitudinal narrow ovals, open in front. The projecting supraorbital portions of the frontal bone with the nasals have a tripodal form. The lachrymal fossa looks outwards, upwards and forwards, and the large maxillary foramen outwards. The infraorbital foramen is double, and issues above the contiguous portions of the third and fourth premolars.

The external crescents of the true molars present prominent anterior angles, which form strong vertical ribs. The first superior premolar has a weak, and the second premolar a very strong internal basal cingulum ; there are no other cingula. The diastema is as wide as the diameter of the canine.

The first inferior premolar is one-rooted, and the second two-rooted, and both are longer than wide in horizontal diameter. The middle pairs of incisors are very small ; the external one on each side is much larger, the diameter equaling half that of the canines. The first and second true molars are subequal, and are together longer than the third, which does not quite equal in length the three premolars. The heel of the last molar is not so long anteroposteriorly as each of the other columns. The symphysis is steep, but is everted at the incisive region.

Measurements.	M.
Length of ramus from heel of m. III	.065
" of molar series	.036
" of premolar series	.016
" of second true molar	.011
Width of " " "	.006
Length of third " "	.016
Width of " at front	.006
Length of symphysis in front	.025
Depth of ramus at first premolar	.022
" " second true molar	.025
Width between superior anterior premolars	.014

CYCLOPIDIUS HETERODON sp. nov.

This species is represented by a portion of the right maxillary bone, which supports the last premolar, first true molar, and portions of other teeth. It is a smaller form than the *B. simus*, and differs in several important respects. The infraorbital foramen is single and larger than those of the other species. The fourth premolar, while of the same constitution as that of *M. simus*, is relatively much smaller, not equalling in the extent of its grinding face one column of the first true molar. The latter is prismatic, and of usual form. Its external crescents are not produced as in *B. simus*, so that there are no distinct vertical ribs.

Measurements.		M.
Diameter of last premolar	anteroposterior	.0050
	transverse	.0045
Diameter of first true molar	anteroposterior	.0080
	transverse	.0055

This species was found with the three preceding in the Upper Miocene of Montana by my assistant, J. C. Isaac.

BLASTOMERYX BOREALIS sp. nov.

This genus was defined by me in the fourth volume of the Report of Lieut. G. M. Wheeler to the Chief of Engineers, 1877, p. 350, as not certainly distinct from *Dicrocerus* Lartet. The discovery of a second species of the group, which displays the characters there pointed out, in a still more striking degree than the species on which it was formed, renders it necessary to introduce the genus formally to the system. In brief its molars differ from those of *Dicrocerus* much as those of the deer differ from the molars of the antelope. While *Dicrocerus* was probably the ancestor of *Antilocapra*, *Blastomeryx* was the ancestor of *Cervus* or *Cariacus*.

The superior dental formula is I. 0; C. 0; Pm. 3; M. 3. The molars all have two pairs of crescents excepting the last premolar, where the posterior pair are rudimental. The external face of the anterior crescent in all the molars presents a groove, which is bounded posteriorly by a vertical ridge. The posterior crescent is directed a little inward posteriorly on the true molars. The palate is much contracted in front of the first molars. The horns stand above the posterior parts of the orbits; their section is triangular, the posterior angle being rounded, and the external produced and acute, bounding the orbit outwards and backwards. There is no trace of burr. The temporal fossæ approach so as to be separated only by a rather wide and low occipital crest.

Measurements.	M.
Total length of skull	.320
Length of molar series	.107
" premolar "	.049
" second premolar	.016
Width " "	.011
Length of first true molar	.020
Width " "	.015
Width between bases of horn-cores	.050
Transverse diameter of horn-core two inches from base	.040
Width between external borders of first true molars	.078
Width of palate in front of first premolars	.028

This species was as large as the black-tailed deer, *Cariacus macrotis*. It was found by my assistant, J. C. Isaac, in the Upper Miocene of Montana.

CERVUS FORTIS sp. nov.

This deer is of large size, much exceeding any living species of the family *Cervidæ*. It is represented in my collections by a superior molar of the left side, and very probably by other remains which accompanied it, viz.: a mandibular symphysis with incisor and canine teeth; calcaneum, astragalus, vertebræ, etc. These were found at the same time and place by George M. Sternberg, M.D., U. S. A., already well-known by his interesting discoveries in the cretaceous formation of Kansas.

The plicæ which mark the anterior extremities of the external crescents are very prominent, and are directed forwards rather than outwards. The median lakes are narrow and well separated medially. The posterior lake has a strong fold of its internal border, forming a lobe directed backwards.

A cylinder of small diameter stands near the apex of the fold of the internal enamel wall, which separates the internal crescents. There is a cingular ridge descending inwards on the interior and posterior extremities of the base of the crown, and below and exterior to it the enamel surface is very rugose. The surface of the external enamel is smooth. The enamel of the lake borders is seamed with shallow vertical sulci. The crescents are wide and the lakes narrow.

The reference of this species to the genus *Cervus* may require reconsideration.

Measurements.	M.
Anteroposterior diameter of crown	.052
Transverse do. in front	.035
Width of anterior external crescent	.018
Elevation of crown externally	.020

From the pliocene formation of Oregon.

The Loup Fork beds have been usually referred to the Pliocene horizon, but I have offered reasons why they should be regarded as of Upper Miocene age. The horizon from which this and some other species herein described, found in Oregon, represent the Pliocene formation much more nearly.

DICOTYLES SERUS, sp. nov.

This species of hog is indicated by a mandibular ramus which lacks the angles, and supports the dentition of both sides excepting the third right molar. Other portions of the skeleton are associated. A second specimen is the symphysis with the incisor teeth. The remains indicate an animal something larger than the white lipped peccary *Dicotyles labiatus*.

Dentition of the mandible, I. 2 ; C. 1 ; P. m. 3 ; M. 3. Inferior canines triangular ; superior canines decurved, triturating the inferior. Last inferior molar with well developed heel. Last premolar like the first molar. First premolar with anterior single tubercle and posterior lower tubercle heel ; second premolar similar but wider, and the anterior tubercle divided. Molars consisting of four principal tubercles opposed in pairs, with some accessory ones between them.

The rami are robust and of moderate depth ; the symphysis is elongate and contracted. The suture of the latter remains on the inferior side, but is obliterated on the upper surface. The symphysis is trough-like and the narrow alveolar ridges of the diastema are concave inwards.

The incisor teeth are directed forwards, and are closely approximated and parallel. The fang of the second lies close to that of the canine, and the edges of the crowns together form a parabola, the enamel being prolonged posteriorly on the external side of the external tooth. The crowns of the median teeth are not expanded laterally, nor much depressed at the apex ; as half worn in the specimen, they form a wide transverse oval. The canines curved upwards and outwards and present their triturating surface a little external to directly backwards. Their section is triangular, the lateral faces being longer than the posterior, and the anterior angle is a narrow one. The surface of the enamel cannot be described, as it is eroded at some points. The diastema is long.

The first (homologically second) premolar is narow, and is without lateral or posterior lobe or cingulum, but a third is a rudimental lobe at its anterior base. The heel presents an interior tubercle, and a narrow postero-external lobe which embraces a medeo-external tubercle. The latter becomes the external posterior tubercle on the true molars. The third premolar is larger and wider than the second ; the medio-external lobe becomes more external and posterior, and a median tubercle appears in front of it. The posterior tubercle still sends a narrow ledge round to the outer base of the medio-external lobe. The anterior lobes are more elevated than the others, and are only separated by a fissure. In the fourth premolar the true molar structure is seen in the regular quadri-tuberculate form. There is a small tubercle in front and behind the notch of lobes, and a fold descending forwards on the outer side of the external posterior lobe. In the second true molar there is an additional tubercle on the middle line between the pairs of lobes. The median accessory tubercles are not distinct on the last molar, excepting the posterior, which becomes a large heel. The lobes of each pair are not deeply separated on the last two molars. These teeth are rather abruptly larger than the first true molar, which is little larger than the last premolar. Each of them has a narrow anterior cingulum, but no other. The enamel is nearly smooth.

Measurements.		M.
Length of mandible from end of posterior molar to incisive alveoli		0.190
Length of molar series		.103
" true molars		.062
" diastema		.054
Width between bases of canines		.020
" of diastema		.024
" between bases of first premolars		.032
Diameter of p. m. 2	antero-posterior	.012
	transverse	.007
Diameter of p. m. 4	transverse	.015
	antero-posterior	.012
Diameter of m. 2	antero-posterior	.021
	transverse	.016
Diameter of m. 3.	antero-posterior	.026
	transverse	.015

The animal from which the above description was taken was adult. It was discovered in the Loup Fork beds of North-Western Kansas by Russell Hill of this city.

TETRALOPHODON CAMPESTER sp. nov.

The cranium and under jaw, with nearly complete dentition, including tusks, of this species, were obtained by my assistant, Russell S. Hill. The animal is mature but not old, as the second true (third intermediate) molar is present and much worn, and the last molar is worn on its anterior three-fifths.

The posterior or fourth crest of the second true molar is narrower than the third, and is not followed by a heel. The third molar presents six transverse crests, and so large a heel that it might be said to be seven-crested. Each crest is sub-transverse, and is composed of a principal obtuse cone at each extremity and some smaller ones between, in close contact. The apices of the larger ones approach each other, and the median ones are less elevated. The section produced by wearing of the third and second crest each, is that of two trefoils placed base to base, and the lateral lobes of these, completely close the valley between those crests. The valleys between the other crests are closed by one or two distinct median tubercles, and the sections of those crests are less accurately trifoliate than those of the others. There is a very large cingulum at the anterior extremity of this tooth whose worn section is confluent with both of the trefoils of the anterior crest near the middle. A portion of it is isolated on the inner side of the crown, forming a flattened cone, or when worn, an isolated oval with the long axis directed inwards and forwards. This I have counted as the first crest, as it is as much entitled to it as the one so counted by Dr. Falconer, in the *T. sivalensis*. The palate is narrow, not exceeding the width of the second true molar.

The mandibular rami are of rather light tissue, and are compressed in form, the external face being little convex. The symphysis is produced, without abrupt contraction either laterally or below, into a robust beak whose depth is equal to the width five inches beyond the bifurcation. It is channeled above by a narrow and deep groove, and supports no tusks. From the appearance of the tissue when fractured transversely it is evident that there have been no alveolar cavities at any time. The beak is slightly decurved and the extremity is depressed and transversely flattened. The superior incisor possesses a broad band of enamel, which covers nearly one-third the diameter of the tooth.

Measurements.	M.
Length of crown of second true molar	.118
Width " " "	.075
Length " third "	.195
Width " " "	.080
" palate at anterior extremities of second molars	.045
" " posterior crests of third "	.095
Length of ramus from posterior border to bifurcation	.500
Length of symphyseal beak (broken)	.480
Depth of do. five inches from bifurcation	.118
Width of do. at do.	.115

This fine new *Mastodon* is the second species of the genus *Tetralophodon* found as yet in North America, the first being the *T. mirificus* of Leidy.

It is well distinguished from this form by the structure of the component parts of the crown of the last molar tooth, and by its long symphysis, that of the *T. mirificus* possessing the more usual short spout. It is with the *T. longirostris*, of Eppelsheim and the valley of the Danube, that the closest affinity exists. In *T. campester* the symphyseal production is much more robust, not being separated from the rami by any constriction, as in *T. longirostris*. It is moreover without incisive tusks, but it is yet uncertain what value should be attached to this character, as it may turn out to be individual or sexual. In the intimate structure of the molars there is considerable resemblance to the *T. longirostris;* that species is however stated by Dr. Falconer* to possess but five crests and a heel on the last molar. The presence of the enamel band on the tusks also separates the *T. campester* from that species, where, according to Mr. Vacek,† it is wanting.

In comparison with *M. sivalensis*, this Mastodon differs in the transverse character of the valleys; in the Indian species the tubercles alternate and close them.

The dimensions of the *T. campester* are those of the African Elephant.

From the Upper Miocene and Loup Fork horizon of Kansas.

TAXIDEA SULCATA sp. nov.

This badger is represented by the nearly entire maxillary bone of the left side containing all the teeth excepting the canine and first premolar. It resembles the corresponding portion of the *T. americana* very nearly, but differs in two important features. The first of these is the abbreviation of the anterior portion of the dental series. The first premolar is closely wedged in between the canine and second premolar, so that its anterior root is almost obsolete. The head was thus doubtless relatively shorter than in the existing species where there are hiatuses between the roots of the first premolar and adjacent teeth. The second character is seen in the last or true molar. On its crown the tubercles are arranged in two well separated transverse rows, forming crests by their confluence, which are separated by a deep valley, and bound by a half valley in front and rear.

Measurements.	M.
Length of series, including canine	.038
" premolars	.023
" last premolar	.011
Width of " "	.009
Length of last molar (inside)	.012
Width " "	.010

From the Pliocene of Washington Terr.; found by Major Truax, U.S.A.

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* On British and European Fossil Mastodons, p. 19 (8 vo.).

† Ueber Oesterreichische Mastodonten Wien, 1877, p. 31 (Abh. K. K. Geol. Reichanstalt).

PSEUDEMYS BISORNATUS sp. nov.

This fresh water tortoise is represented by portions of three individuals. These exhibit a rather flattened convex carapace, with marginal bones united (behind the bridge at least), without gomphosis, by fine suture. There are no median or lateral keels. The vertebral bones are nearly as wide as long, and thick; the costals are thickest proximally and thinnest medially. The marginals are quite stout. The dermal scutal sutures are deeply impressed, especially those defining the marginal scuta.

The sculpture of the superior surface of the carapace is strongly marked and peculiar. The vertebral scutal areæ are smooth, or display only a few obscure ridges directed backwards and inwards, on the proximal portions of the costal bones; the vertebral bones being smooth. The costal scuta present two forms of sculpture; posterior to the intercostal bony suture each is reticulated with inosculating sharp ridges whose general direction is longitudinal proximally and transverse distally. The sculpture is Trionyx-like, and rather coarse. The surface anterior to the osseous suture, is ornamented with raised, parallel ridges, which are separated more widely than those of the posterior half of the scutum, and which do not inosculate. They continue uninterruptedly to the succeeding osseous suture, to be followed again by the reticulate pattern. Thus each costal bone is divided into three areas; a proximal smooth one, and an anterior reticulate, and posterior ridges areæ, separated by a deep sutural groove.

A postero-lateral marginal bone unites subequally with two costals. Its superior surface rises in abrupt convexity beyond the costo-marginal dermal suture, and from the transverse intermarginal dermal suture. It is then concave to the recurved margin. Its sculpture consists of transverse ridges, separated by grooves of equal width.

Measurements.		M.
Length of a vertebral bone		.035
Anterior width of same		.032
Thickness of same anteriorly		.009
Extent of median costal	antero-posterior	.035
	transverse	.117
Median thickness of do.		.006
Distal " "		.007
Length of a posterior marginal		.030
Width " "		.042
Thickness " "		.017

This tortoise is at first sight apparently singular in its marks of ornamentation. On comparison with existing species, however, it is seen to present an exaggerated condition of the sculpture characteristic of some of the existing *Pseudemydes* of our Southern rivers; e. g. the *P. elegans*. It is more robust in all its proportions than any of these.

The fossil remains were discovered by my friend, G. W. Marnock, in the pliocene of South-western Texas.

CISTUDO MARNOCHII.

Represented by the posterior lobe of the plastron of an individual of twice the bulk of the existing North American *Cistudos*. It is broadly rounded posteriorly, and there is an emargination at the femoro-anal dermal suture. The anterior suture is straight, as is also the lateral, which measures more than a third the length of the entire lobe. On the upper side of the angle included by these sutures is the fossa for fixed attachment with the carapace. The beveled face of the fore edge of the lobe is quite wide. The dermal sutures are well marked. The anal scuta are large, their median length being half that of the lobe. The common femoral suture is only half as long as the ventral. The inferior surface is nearly flat in every direction; and the surface is smooth. The posterior border of the specimen is broken away.

This species was obtained from the same formation as the last, by Gabriel W. Marnock, to whom I dedicate it.

ANCHYBOPSIS BREVIARCUS sp. nov.

The genus to which the above name was given, was established by the writer in 1870, for a species Cyprinoid fish, from the pliocene formation of Idaho. Its affinities were then stated to be to *Alburnops* (*Hybopsis*), and related existing genera. The present paper describes two additional species of the genus, both of which are represented by pharyngeal bones and teeth of both sides. The teeth are shown to be 5–5, in contradistinction to the genera *Hemitremia* and *Alburnops*, where they are 5–4 and 4–4 respectively

In this fish the common base of the pharyngeal teeth rises upwards, so as to project well in front of the general plane of the bone. The superior teeth are more compressed than the inferior, and the first and second counting from below, have convex grinding faces. The pharyngeal bone has a short inferior and a long superior limb. The alate portion is regularly and strongly convex, without abrupt expansion. The nutritive foramina of the anterior face are two large inferior and several small superior ones.

Measurements.	M.
Vertical extent of bone in a straight line	.020
Width at second tooth	.008
" at first "	.004
Length of tooth line	.011
" of third tooth	.005
" of basal limb to first tooth	.009

This species is of smaller dimensions than the *A. latus*.

ANCHYBOPSIS ALTARCUS sp. nov.

The pharyngeal bones of this cyprinoid are larger and of more slender proportions than those of the *A. breviarcus*. Specimens from both sides are preserved. The inferior and superior limbs are both elongate, the former slender, the latter flat. The ala is abruptly expanded at right angles to the long axis; the external border is thence nearly straight to, and the angle of the superior border situated interiorly to, the line continuing the inner border upwards. The tooth line is elevated at the upper extremity. The basal teeth are more robust than the others, and do not present grinding faces. The nutritive foramina are more numerous and smaller than in the *A. breviarcus*.

Measurements.	M.
Vertical extent of right pharyngeal	.023
Width at second tooth	.009
" at first "	.004
Length of tooth line	.012
" of third tooth	.006
" of basal limb to first tooth	.011

Found with the last species by Chas. H. Sternberg, in the Pliocene deposit of Oregon.

ALBURNOPS ANGUSTARCUS sp. nov.

Represented by the pharyngeal bones of both sides, of a species of about the size of the one last described. The characteristic marks of these are seen in the long extremities, both inferior and superior, and in the very slight convexity of the ala, which is less prominent than in any of the *Cyprinidæ* here described. The superior end of the tooth basis is elevated and prominent. In one of the jaws all the teeth display a masticating surface. In the other the second tooth, the only one preserved, is partially worn.

The length of the proximal limb distinguishes this pharyngeal bone from that of the *Anchybopsis breviarcus*, if the generic characters be disregarded. From all the other species the slight prominence of the ala separates it.

Measurements.	M.
Vertical extent of right pharyngeal	.023
Length of proximal limb	.010
" of tooth line	.010
" of distal limb	.012
Width at first tooth	.005
" of second tooth	.007
Length of third tooth	.005

Found by Mr. Sternberg, with the last species.

ALBURNOPS GIBBARCUS sp. nov.

One left and two right pharyngeal bones furnish the characters of this species. Their form is angulate, as in the *Anchybopsis altarcus*, but shorter in the vertical direction. The proximal limb is rather short, and the distal one not as long as in the species last described. The ala widens abruptly at the inferior margin, and the thin superior edge of the superior limb is obtusely angulate. The nutritive foramina are rather numerous. The first and second teeth display little or no grinding surface.

Measurements.	M.
Vertical extent of right pharyngeal	.020
Length of proximal limb	.009
" of tooth line	.009
" of distal limb	.009
Width at first tooth	.004
" at second tooth	.008
Length of third tooth	.005

Found by Chas. H. Sternberg in the Pliocene of Oregon.

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On some Saurians found in the Triassic of Pennsylvania, by C. M. Wheatley.

BY E. D. COPE.

(*Read before the American Philosophical Society, Dec.* 21, 1877.)

THECODONTOSAURUS GIBBIDENS sp. nov.

The only remains of this saurian which have come into my hands are two teeth. They are in good preservation, lacking only the great part of the root. They present the leaf-like outline characteristic of the genus, the crown being strongly distinguished from the narrower root. The form is quite robust, and contracts gradually to the apex. The cutting anterior and posterior edges bound the inner face of the crown, from which they are separated by a groove along their bases. They are interrupted by coarse serrations, the apices of the denticles being directed upwards. These are much reduced in size at the base of the crown. The cutting edges are not separated from the external face by grooves. This face is very convex and perfectly smooth. The inner face is convex between the grooves and is marked with six or seven continuous sulci, which are obsolete at the base.

The saurian which possessed the tooth described was not of large proportions. The species differs from the English form in many respects; e. g., the greater convexity of the external face; the basal grooves of the cutting edges, the grooving of the inner face, the abrupt constriction below the base of the crown, etc.

Measurements.		M.
Diameter of crown	antero-posterior	.0070
	transverse	.0045
Length of crown		.0038

PALÆOSAURUS FRASERIANUS sp. nov.

But few remains indicate this species. It is established primarily on a tooth, which presents the characters of *Palæosaurus cylindrodon*. It has opposite denticulate cutting edges, an anterior and posterior, of which the latter extends to the base of the crown, and the anterior but half way from the apex. The posterior is denticulate throughout, while denticulation is visible on the anterior edge for but one-third the distance from the apex. The posterior edge is more compressed. The surface of the cementum is obsoletely finely linear ridged, and there are no sulci or other sculpture. The crown is regularly and gently curved backwards.

Measurements.	M.
Length of the crown	.0200
Antero-posterior diameter of crown at base	.0065

This saurian is dedicated to my friend, Persifor Frazer, Jr., in charge of one of the districts into which the State of Pennsylvania is divided for the conduct of the second geological survey. This district embraces the Triassic region, which has been extensively and ably investigated by Prof. Frazer.

SUCHOPRION AULACODUS Cope.

Palæoctonus aulacodus Cope, Paleontological Bulletin, No. 26, p. 184.

Several additional teeth of this species show that the tooth from which I first determined it is one of the flattest of the series, and that those from other positions in the jaws, instead of being flatter as in *Palæoctonus*, are narrower, and of the usual form of those of *Suchoprion*.

This saurian possesses teeth of the size of the average of those of the *S. cyphodon*, and which are like them, well compressed in the antero-posterior direction. The surface is therefore very convex between the cutting edges, especially on the external face, and the transverse diameter at the base of the crown exceeds the antero-posterior. The cutting edges only extend half way from the apex, and are but little denticulated. The surface of the cementum is minutely and sharply linearly sculptured. It is in addition, thrown into coarse continuous grooves on the basal two-thirds of the crown, excepting for a short distance on the inner side of each cutting edge. There are seven grooves on the inner face, and eighteen on the outer face. On the latter the minute sculpture is least distinct.

Measurements.		M.
Length of crown		.0260
Diameter of base of crown	fore and aft	.0160
	transverse	.0115

The short slightly denticulate cutting edges and the strongly grooved surface distinguish the anterior teeth of this species at once from the *S. cyphodon*. Several specimens have been found by Mr. Wheatley.

On the Vertebrata of the Dakota Epoch of Colorado.

BY E. D. COPE.

(Read before the American Philosophical Society, December 21, 1877.)

Not long since I was informed by the Superintendent of Public Schools of Fremont County, Colorado, Mr. O. W. Lucas, that he had discovered the bones of an enormous saurian at an outcrop of the rocks of the Dakota group not far from Canyon City. I encouraged him to proceed with the exploration, and asked him to send some specimens which would explain the character of his discovery. One of the first objects sent, is a fragmentary lower jaw of a carnivorous dinosaurian, which he found on the surface of the ground. This fossil was found to belong to a species heretofore unknown, which I referred to the genus *Laelaps*, under the name of *Laelaps trihedrodon.*[*] The second sending included a number of vertebræ, which apparently represent a much more gigantic animal, and I believe the largest or most bulky animal capable of progression on land of which we have any knowledge. This reptile I described in my paleontological bulletin No. 26, under the name of *Camarasaurus supremus*. Subsequent sendings included many of the more important bones of the skeleton, which render it comparatively easy to determine the general character of this monster. Later collections received from Mr. Lucas include the teeth of two large species of a new genus which has been characterized under the name of *Caulodon;* and the vertebræ of three genera new to science, which I have named *Tichosteus*, and *Symphyrophus*. He also procured remains of two additional forms of gigantic size, fit rivals of the *Camarasaurus*, which I referred to the new genus *Amphicœlias*. A species of tortoise was associated with these saurians, and appears to have been abundant. It is the oldest species of the order yet obtained from American formations, and is not very different from existing forms. .

The above named genera are the only ones from the Dakota horizon of this continent which have been defined, up to the present time.

The species of *Camarasaurus* and *Amphicœlias*, which attained to the most gigantic proportions, are remarkable for the light construction of the vertebræ anterior to the tail. In both genera the centra of the dorsal vertebræ are hollow, including two large chambers which are separated by a longitudinal median wall, and which communicate with the cavity of the body by a foramen on each side. They are also remarkable for the enormous elevation of the superior arches, and diapophyses, the result of which is to give the ribs an unusually elevated basis, and the cavity of the body much space above the vertebral axis on each side. On the other hand the bones of the tail and limbs are solid or nearly so, in great contrast with some of the *Dinosauria* of later geological periods. Another peculiarity of the genus *Camarasaurus* at least, is the probable great length of the anterior limbs. The scapula is enormous as compared with the pelvic bones. The sacrum is also small and short, showing that the weight was not borne on the hinder limbs. The great length of the humerus in the probably allied genus *Dystrophæus*, from the Trias of Utah, adds to the probability that the same bones were large in *Camarasaurus*. This character, taken in connection with the remarkably long neck possessed by that genus, suggests a resemblance in form and habits between those huge reptiles and the giraffe. While some of the later *Dinosauria* elevated themselves on their hind limbs to reach the tree-tops on which they fed, the general form of the body in some of these earlier types enabled them to reach their food without the anterior limbs leaving the earth.

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[*] Bullet. U. S. Geol. Surv. Terrs. III, 1877, p. 805.

Another remarkable peculiarity which these genera share with *Dystrophæus* and *Cetiosaurus* is the irregular and pitted character of the articular extremities of some of the bones. This indicates a cartilaginous covering, and probably in some instances an osseous cap or epiplysis.

Dr. Hayden visited the locality of Mr. Lucas' excavations, and informs me that the formation from which the *Camarasaurus* was obtained, is the Dakota. Prof. Marsh has attempted to identify what is, according to Prof. Mudge, the same horizon, one hundred miles north of Canyon City, with the Wealden of England. Specimens from the northern locality which I have examined render it certain that the horizon is that of Mr. Lucas' excavations. Of this I may say that there is no paleontological evidence of its identity with the Wealden. The resemblance of the vertebrate fossils to those of the English Oolite is much greater, but not sufficient as yet for identification.

The discovery of *Vertebrata* in the strata of the Dakota epoch is an important addition to the geology and paleontology of North America. The numerous geologists who have explored its outcrops have failed hitherto to observe remains of this class of animals. Credit is due to Superintendent O. W. Lucas for this discovery, and also in an especial manner for the skill and care he has exercised in taking out and shipping the ponderous specimens.

CAMARASAURUS Cope.

Palæontological Bulletin No. 25, p. 5; (published August 23, 1877).

The characters of this genus are derived from nearly all portions of the skeleton excepting the skull and ungues. The bones are generally in good preservation.

The vertebræ of the cervical, dorsal and lumbar region are all opisthocoelous or reversed ball and socket. The centra of the cervicals are very elongate, but those which follow them diminish rapidly in length, until in the lumbar region they have but a small anteroposterior diameter. The anterior caudal vertebræ are also very short and wide; but the length of the centra gradually increases, so that the distal ones are quite elongate. The caudal centra are all moderately amphicoelous.

The centra of the cervicals and dorsals are hollow, and the interior chambers communicate with the cavity of the body by a large foramen on each side, which is below the base of the diapophysis. In the cervical vertebra it is very elongate, and extends between the bases of the parapophysis and diapophysis. In the dorsal centra there are but two chambers, which are separated by a longitudinal median septum.

The neural arches are coössified with the centrum throughout the column. They are extraordinarily elevated, and their antero-posterior diameter is small. The zygapophyses are at its summit, and have extensive articulating surfaces. The anterior pair are divided by a deep median fissure, while the posterior are united, and support as a pendant from their inferior median line a *hyposphen*, a structure more fully described under the head of the genus *Amphicoelias*, where it is equally developed. When the vertebræ are in relation, the base of the hyposphen enters the fissure between the anterior zygapophyses, and maintains them in position. This structure is obsolete in the lumbar vertebræ.

The diapophyses rise from the neural arch to a considerable length upwards and outwards, in the anterior dorsals. They become shorter posteriorly, but in none of the vertebræ anterior to the sacrum do they issue from the centrum. In the caudal vertebræ they are short and robust, and issue from the superior part of the centrum, They do not continue far on the tail. Those of the dorsal vertebræ are light and concave below. They are supported by thin osseous buttresses, the most important of which are the two inferior ones. The anterior of these is much the most prominent, and bears the capitular articular facet for the rib. In no case is this surface seen on the centrum, but it descends somewhat in the posterior vertebræ, but not as low as the level of the neural canal.

The neural spines are rather short, and are set transversely to the axis of the animal. The superior portion is expanded transversely, and in an anterior dorsal vertebra, is widely emarginate above, so as to appear double. The neural spines of the caudal vertebræ are compressed and elevated, though thickened at the apex. The zygapophyses are situated low down, and are directed very obliquely. The chevron bones of the caudal vertebræ have short limbs which are not united at the base, and a long common median spine.

The sacrum is short and consists of only four vertebral centra, thoroughly coössified. The anterior articular extremity is convex ; that of the posterior extremity slightly concave. Its transverse processes are, like those of the other vertebræ, much elevated, although they spring from the centra. The external face of their bases is not prominent, and the spaces between their projecting portions are deeply excavated. The centra are like those of the caudal vertebræ, composed of dense bone. The extremities of the adjacent transverse processes are united, thus enclosing large foramina.

The scapula is relatively of large size. It is rather elongate, and the superior extremity is expanded. There is a very large mesoscapular process, which is wanting in *Cetiosaurus*, according to Phillip's figures. It appears to resemble the scapula in *Dystrophæus*.* The two proximal faces, the glenoid and the coracoid, are well distinguished, and their surfaces are like the corresponding faces of other bones, pitted coarsely.

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* See Report of Lt. Wheeler, Vol. IV, pl. LXXXIII, p. 31.

The coracoid bone is of proportionately small size. It is of an irregularly quadrate form, with the proximal extremity the shortest. The articular face is large, and is presented obliquely away from the long axis of the plate. There are no emarginations nor intermediate processes, and the perforating foramen is well removed from the border.

Pelvic bones of two forms are present. Neither of them resembles pelvic bones of *Dinosauria*, and are least of all similar to the forms of ilium which are known in that order. One of them is a robust L-shaped bone, one limb of which is expanded into a wide fan-shaped plate; and the other is stouter and of sub-equal width, terminating in a stout sub-triangular articular extremity. The face of this limb of the bone which looks away from the fan-shaped plate is concave throughout its entire length, forming a large part of the acetabulum. Both edges of this cavity are free and rounded. The absence of articular faces above the acetabulum renders the identification of the bone with either pubis or ischium difficult. The second pelvic bone is larger than the first, and unlike it, is in one plane. Its form is that of a low triangle with a long base, at each extremity of which the angles are truncated. The "basal" border is gently concave in the long direction and thick and convex in the cross-section, The two "sides" of the triangle are rather thin margins, but one of them is thicker than the other. One extremity of the bone is more robust than the other, and is divided into two planes. The one is transverse and sub-triangular, and applies to the extremity of the stout or acetabulum limb of the other pelvic bone. The other is smaller, is oblique and concave, and when the two bones are placed in relation, forms a continuation of the acetabular surface already described. Within this and the proximal portion is a large foramen which resembles the pectineal perforation of the pubis.

The femur is long and without prominent third trochanter, this process being represented by a low ridge. The condyles have an extensive posterior sweep, and are separated by a shallow trochlear groove in front. A tibia which was found with the other bones, is much shorter than the former, and has a much expanded head. It is very robust, especially at the distal extremity. The astragalus was evidently distinct from it. A metapodial bone is very robust. Its extremities are much expanded, and the shaft contracted, and it is furnished with a prominent median keel on one half of its posterior aspect.

Several genera have been described, which possess some of the features presented by those to which the present animal belongs. The following are characterized by the presence of the lateral sinuses of the vertebral centra: *Megadactylus* Hitch., *Cetiosaurus* Owen, *Ornithopsis* Seeley, *Bothrospondylus* Ow., and *Pneumatarthrus* Cope. The first of these may be dismissed with the remark that its caudal vertebræ possess the sinuses as well as the dorsals, which we have seen is not the case with the Colorado animal. The centra of *Cetiosaurus* according to Owen, and those of

Pneumatarthrus, do not exhibit the cavernous structure above described, but are uniformly spongy interiorly. *Ornithopsis* of Seeley, which Owen refers to his subsequently described *Bothrospondylus*, possesses a cavernous cellular structure, which I have not found in the reptile from Canyon City, Colorado, but which occurs in the huge saurian discovered by Prof. Lakes, near Golden, Colorado, in the same stratigraphical horizon. Another name (*Chondrosteosaurus*) has been introduced by Prof. Owen, but he gives no characters, nor points out how it differs from *Ornithopsis*, which it resembles in its cellular structure.

A short time prior to my publication of the description of the genus *Camarasaurus*, Prof. O. C. Marsh of New Haven issued a description of a portion of a sacrum of a saurian found in the Dakota beds near Morrison, Colorado, a point one hundred miles north of Canyon City. To the animal to which the sacrum belonged, Professor Marsh gave the name of *Titanosaurus montanus*. As the name of the genus was not accompanied by any generic diagnosis or specific reference to its characters, it has no claim to adoption according to the rules of nomenclature, nor is the genus distinguished from some of those above enumerated. Especially is there nothing to indicate that it differs from *Ornithopsis* or *Bothrospondylus*. The name given has also been already employed by Dr. Lydekker of the Geological Survey of India.

CAMARASAURUS SUPREMUS Cope.

Paleontological Bulletin, No. 25, p. 7; Aug. 1877.

The bones of this species so far discovered by Mr. Lucas are:—a cervical and twenty dorsal and lumbar vertebræ, with twenty caudals. Both scapulæ and coracoids were recovered, with one-half of the sacrum, and two pairs of pelvic bones. Of the hind limb I have the femur, with a tibia less certainly belonging to the same animal, although found among the other bones. There is one metapodial. There are many other bones which I have not yet reconstructed or determined.

The dimensions of this animal may be inferred from the fact that the cervical vertebra is twenty inches in length and twelve in transverse diameter; and that one of the dorsals measures three and a half feet in the spread of its diapophyses, two and a half feet in elevation and the centrum thirteen inches in transverse diameter. Another dorsal is two feet ten inches in elevation. The scapula is five and a half feet in length and the femur six feet.

The centra of these vertebræ bear a ball and socket articulation of the opisthocoelian type, the cups and balls being well pronounced; just beneath the diapophysis is situated a huge foramen. A broken centrum from which Mr. Lucas removed the matrix, shows that this foramen communicates with a huge internal sinus, which occupies almost the entire half of the body of the vertebra. Those of opposite sides are separated by a septum which is thin medially. Thus the centra of the dorsals are hollow. The neural arches are remarkable for their great elevation, and the great expanse of the zygapohpyses. They are more remarkable for the form of the neural spines, which are transverse to the long axis of the centrum. That of one of the vertebræ is strongly emarginate so as to be bifurcate. The widely extended diaphophyses support the rib articulations, and there are no capitular articular facets on the centra.

The cervical vertebra is depressed, the anterior or convex extremity of the centrum the most so. It is remarkable for its elongate form, exceeding the proportions found in known *Dinosauria* and *Crocodilia*, and resembling that seen in some fluviatile tortoises. Near the anterior extremity a short, robust parapophysis has its origin, from which it extends outwards and downwards, and soon terminates in a truncate extremity which presents downwards. A deep fossa occupies its upper base, and above this a deep linear foramen extends throughout the greater part of the length of the centrum. If this vertebra possesses a diapophysis it is rudimental.

The caudal vertebræ are amphicœlian, but not deeply so. They are subquadrate in section, and not so short as the corresponding ones of *Hadrosaurus*. The most anterior one of the series has short, robust diapophyses, and is more concave anteriorly than posteriorly. The other caudals are more equally biconcave, but the cavity is very shallow on the most distal of them. The centrum is relatively more elongate and compressed than those of the others. None of them display the lateral pneumatic fossa which exists in the dorsals, and where broken so as to permit a view of the internal structure, the latter appears to consist of rather finely spongy tissue. The chevron facets are not very well defined, and the neural spines are of usual forms, and on two anterior vertebræ elongate.

Many peculiarities are exhibited by the vertebræ of this species, which are not described in saurians known up to the present time. Many of these would have been lost in less careful hands than those of Mr. Lucas, and science is much indebted to him for the preservation of many walls and buttresses of light proportions. In general the external walls of the centra are thin, and the processes are composed of laminæ united by narrow margins. The vertebræ are lighter in proportion to their bulk than in any air-breathing vertebrate.

The anterior extremity of the centrum of the cervical vertebra is prominently convex, and much depressed. The posterior and concave extremity is wider, and of rather greater vertical diameter. The base of the neural arch only occupies half of the length of the centrum, an equal extent of the superior surface extending freely beyond it at its anterior and posterior extremities.

The linear lateral foramen commences a little behind the anterior base of the neural arch, and descending somewhat in its direction, terminates beneath the posterior extremity of the base of the neural arch. The base of the latter overhangs the foramen and the base of the transverse process. The interior surface of the centrum is concave, the concavity being bounded in front by the inferior convex thickening of the extremity. Behind the middle the surface becomes plane, and is, near the posterior extremity, bounded on each side by a short angular ridge.

Measurements.		M.
Length of centrum between anterior convexity and posterior lip		.565
Depth of posterior cup		.090
Diameter of cup	vertical	.310
	transverse	.160
Length of parapophysis		.095
Width of neural canal		.063

The dorsal vertebra which I suppose the anterior one of those received, is characterized by the lack of the median portion of the neural spine, and the extension outwards of the median lateral processes described above. The diapophyses are much longer, and the zygapophyses more extended transversely. The centrum is constricted at the middle, and especially just behind the convex articular extremity, whose circumference forms a prominent rim. The edges of the lip are flared outwards, forming a deep basin, much wider than deep. The fossæ described in other vertebræ are present in this one, but differs in proportions, owing to the greater size and expanse of the superior parts of the neural arch. The fossa posterior to the base of the diapophysis is nearly plane, while that at the anterior base is deeply excavated, is narrower, and extends so far along the inferior side of the process as to give it a semi-circular section near the middle. Distally the diapophysis has a trialate section, owing to its three longitudinal ridges, and the articular extremity is large and antero-posterior in direction. The process differs from that of the vertebra next described, in the possession of a facet near the middle of its anterior inferior bounding ridge, which is probably costal, as in the vertebra of *Crocodilia*. The lateral foramen of the centrum is subround. The general surface is smooth.

Measurements.		M.
Total elevation of vertebra		.770
" transverse extent of diapophyses		1.010
Diameter of centrum	longitudinal	.300
	vertical of cup	.250
	transverse of cup	.340
	" at middle	.205
Elevation of zygapophysis above centrum		.310
Diameter of zygapophysis	transverse	.170
	antero-posterior	.090
Width of neural canal		.085
Transverse extent of neural spine		.440
Length of diapophysis from posterior zygapophysis		320
Antero-posterior width of end of diapophysis		.135

A dorsal vertebra from a more posterior position, is characterized by its undivivided transverse neural spine. The entire neural arch is of enormous elevation, but as the zygapophyses are above its middle, the neural spine is not as long relatively as in various other genera or as in the caudals of this one. The sides of the centrum are strongly concave, and the borders of the cup flaring. The neural arch is everywhere excavated, so as to reduce the bulk, and produce lightness so far as consistent with strength. The diapophysis rises from a point above the neural canal. It sends a narrow ridge down to the sides of the latter, on each side of which its shaft and base are deeply excavated. The posterior of these fossæ is overlooked by the wide zygapophysis; and the roof of the anterior one supports the anterior zygapophysis. The former are separated by another and vertical septum, which bifurcates below, forming two prominent borders of the neural canal. At each side of the base of the neural canal there are two trilateral fossæ, of which the anterior is much the larger and extends higher upon the lateral edge of the spine, They are separated by a lamina. The diapophysis is not very long and is subtriangular in section near the extremity. The neural spine is thickened at the extremity as though for the attachment of a huge ligament, At the summit of its posterior basal fossa, at the middle of its height, is an outwardly curved process with a smooth extero-superior face.

Measurements.	M.
Length of centrum	.275
Total elevation of vertebra	.880
Elevation to posterior zygapophyses	.550
" of superior edge of diapophysis above centrum	.350
" " neural spine above posterior zygapophyses	.295
Length of diapophysis behind	.215
Depth of extremity of do. (restored)	.075
Transverse extent of summit of neural spine	.215
" " neural spine at middle	.330

In a dorsal vertebra from a more posterior position, the centrum is larger. The capitular costal articulation occupies a lower position, its inferior edge being in line with summit of the neural canal. The lamina which supports it is separated from the anterior lamina which is at the base of the diapophysis, by a deep cavernous sinus. The posterior zygapophyses send upwards to the broad neural spine a median buttress each, which enclose a fossa with the marginal buttress of the same. The hyposphen is represented by a vertical lamina only.

	M.
Total elevation of vertebra	.900
Elevation of neural spine	.300
" " " distally	.280
Diameter posterior articular face of centrum	.360

A lumbar vertebra displays a greater expanse of the posterior articular extremity, which is expanded like a dish. The neural arch and transverse processes have a small fore and aft diameter, and the lateral caverns at the base of the diapophysis are obsolete. The pneumatic foramina are slightly higher than long. Posterior zygopophyses are wanting.

		M.
Diameter of centrum	vertical	.380
	transverse	.420
	antero posterior	.170
Expanse of diapophyses		.590
Vertical extent of base of diapophysis to capitular surface		.200

A proximal caudal gives the following

Measurements.		M.
Total elevation		.560
Diameter of centrum	antero-posterior	.170
	transverse	.245
	vertical	.245
Antero-posterior diameter of neural spine		.075
Elevation of the neural canal		.040
Diameter of median caudal	fore and aft	.180
	vertical	.200
	transverse	.192
Diameter of posterior caudal	fore and aft	.155
	vertical	.175
	transverse	.145

A distal caudal of the elongate type has the following dimensions :

		M.
Diameter of centrum	antero-posterior	.155
	transverse	.125
	vertical	.100

The long diameter of the basis of the transverse processes of the large anterior caudal vertebræ is directed obliquely upwards and forwards. The anterior faces of some of these centra are flat.

The length of the sacrum is M. 0.900 ; elevation of first sacral rest, 0.500.

The head of the femur is subround. One side of the shaft is damaged, so that the form of its section cannot be ascertained. The side of the inner condyle is quite flat, and without epicondylar rugosity.

Measurement of femur.	M.
Length	1.820
Antero-posterior diameter of head	.310
" " " internal condyle	.450

The anterior and posterior edges of the scapula are thin. The posterior is slightly concave, with a slight projecting irregularity near the middle, and is then turned decidedly backwards, bounding the glenoid extremity. The glenoid face is concave, and longer than the coracoid suture. The anterior border is more strongly concave, the distal extremity being more expanded forwards. The sides of this extremity are slightly rugose with coarse grooves. The articular facets are pitted. A low keel extends along the external side of the mesoscapula.

Measurements.	M.
Total length	1.517
Width distally	.680
" at middle	.325
" at mesoscapula	.810
Length of glenoid face	.400

The articular extremity of the coracoid is recurved and very robust. The borders of the bone are thick and roughened.

Measurements of Coracoid.		M.
Diameter	extero-internal	.690
	antero-posterior	.560
	vertical proximally	.

Measurements of Metapodial.		M.
Diameter proximally	transverse	.160
	antero-posterior	.095
Diameter medially	transverse	.075
	antero-posterior	.120
Diameter distally	transverse	.210
	antero-posterior	.105
Length		.270

That this species was capable of and accustomed to progression on land is certain from the characters of the bones of the limbs and their supports above described. The extraordinary provision for lightening the weight of a portion of the skeleton has more than one significance. It must be borne in mind that the caudal vertebræ retain the solid character seen in those genera which stood habitually on their hind limbs. That the present species was herbivorous is suggested simply by its huge dimensions, and the natural difficulty of supplying it with animal food.

AMPHICŒLIAS Cope.

Paleontological Bulletin No. 27, p. 2 (Published December 10, 1877).

The genus to which the above name is now given, is allied to *Camarasaurus*, of which, and the gigantic species *C. supremus*, I have given an account in my Paleontological Bulletin, No. 25. Both genera differ from their nearest ally *Ornithopsis* Seeley, in the excavation of the vertebral centra, so as to include large chambers separated by a septum, which communicate with the external medium by a lateral foramen. In the *Ornithopsis* it is stated that the vertebral centra are occupied by a number of coarse cells. In the more remotely allied *Cetiosaurus*, Owen has observed that the tissue of the centra is coarsely spongy.

The vertebræ from all parts of the column of *Camarasaurus* are known, and those of the dorsal and lumbar regions present the extraordinary character, of which a trace is seen in *Cetiosaurus*, of neural spines expanded transversely to the axis of the column. Numerous vetebræ of *Amphicœlias* are known, and in the dorsals in which the neural spine is preserved, the latter displays the usual form, that is, it is compressed in the direction of the axis of the column. The centra differ from those of *Camarasaurus* in the form of their articular extremities, resembling more nearly in this respect the genus *Tichosteus* Cope (Paleontological Bulletin, No. 26, p. 194). They are unequally amphicœlous, the posterior extremity being more concave, and with prominent margins; while the opposite one is less expanded and is but slightly concave. The neural arch is coössified to the centrum, and there is no capitular costal articulation on the latter.

The manner of the mutual articulation of the neural arches in this genus is peculiar, and is only paralleled in the genus *Camarasaurus*, so far as I can ascertain. The anterior zygapophyses are separated by a deep fissure, while the posterior zygapophyses are united on the middle line. From the latter from the point of junction, there descends a vertical plate which rapidly expands laterally, forming a wedge whose base looks downward. The supero-lateral faces are flat, and articulate with corresponding facets on the inferior side of the anterior zygapophyses, which look downward and inward, on each side of the fissure above described. When in relation, the anterior zygapophyses occupy a position between the posterior zygapophyses above, and the *hyposphen*, as I have termed the inferior reversed wedge, below. This arrangement accomplishes the purpose effected by the zygosphenal articulation, that is the strengthening of the articulation between the neural arches, but in a different way. The additional articulation is placed at the opposite extremity of the vertebra, and it is the anterior zygapophysis instead of the posterior one which is embraced. This structure entitles the genera which possess it to family rank, and as the two genera mentioned above belong to different families in consequence of the different types of vertebral centra, the one opisthocœlous, the other amphicœlous, they may be called *Camarasauridæ* and *Amphicœliidæ* respectively.

The pubis is a stout bone with one slightly concave, thicker border, and an opposite strongly convex, thinner margin. One extremity is truncate; the other presents one transversely truncate and one oblique face. The femur is elongate, and presents a strong postero-external ridge or third trochanter near the middle of the shaft. The head is not separated by a well marked neck, and the great trochanter does not project beyond it.

Thus while there is a striking resemblance to *Camarasaurus* in what may be regarded as adaptive characters, in some important essentials the two genera are very different.

AMPHICŒLIAS ALTUS Cope.

Paleontological Bulletin, No. 27, p. 3.

The centrum of the dorsal vertebra of this reptile is contracted both laterally and inferiorly, so that the margins of the articular extremities flare outwards. The sides are flat, and the inferior surface but little convex in the transverse direction. The pneumatic foramen is situated at the bottom of a large lateral fossa which extends nearly the entire length of the superior portion of the centrum. Its inferior border is sunken abruptly, while the superior gradually shallows on the external surface of the base of the neural arch. The foramen is longer than high, in contradistinction to that of the *Camarasaurus supremus*, where it is round or higher than long.

The neural arch is very much elevated to the zygapophyses. It is strengthened by a prominent rib, which extends from the posterior base upwards and forwards to the base of the anterior zygapophysis. The surface above and behind this is occupied by an extensive excavation whose superior border is the line connecting the zygapophyses. The anterior zygapophyses are separated medially by a deep notch which extends to the base of the neural spine. The articular surfaces incline towards each other. Just behind the anterior zygapophysis, a process extends outwards and forwards whose extremity is lost in my specimen. Its posterior face is excavated by the lateral fossa above described. This process is probably the diapophysis which supports the rib. The diapophysis springs from the line connecting the zygapophyses, and extends upwards and outwards. Its inferior surface is deeply excavated. Its anterior border sends a lamina upwards, which probably reached the side of the neural spine, but is broken off in my specimen.

The neural spine is thin, but its anterior and posterior borders are thickened and double, the lateral rib-like edges being separated by grooves which expand at the base. The posterior groove continues to a more elevated point than the posterior. Each side of the spine is divided into two shallow wide grooves by a median keel. The apex of the spine is much thickened transversely, its obtuse extremity having the fore and aft and transverse diameters equal.

The pubic bone resembles that of the *Camarasaurus supremus*, but is less robust in all its parts. It is also less extended in antero-posterior width near the proximal extremity.

The femur is remarkable for its slender form. It is a few inches longer than that of the *Camarasaurus supremus*, but is not so robust. The shaft is nearly round and somewhat contracted at the middle, where it is slightly convex backwards. It is slightly curved inwards at the great trochanter. Here the shaft is moderately grooved on the posterior face. This trochanter is only a prominent ledge below the head. The third trochanter is situated a little above the middle of the shaft; it is a prominent obtuse ridge directed backwards. The condyles are extended well posteriorly, and are separated by a deep popliteal groove, which originates on the inferior portion of the shaft. They are also separated anteriorly by a shallow open groove. The external condyle is rather more robust than the internal.

The length of the femur is six feet four inches; the elevation of the dorsal vertebra three feet three inches.

Measurements.		M.
Diameter of dorsal centrum	fore and aft............	.245
	vertical	.270
	transverse............	.265

Total elevation of vertebra		1.100
Length of neural spine		.600
Elevation of anterior zygapophyses		.500
Diameter of neural spine	antero-posterior	.160
	transverse (at middle)	.065
	" at summit	.140
Depth of centrum below pneumatic foramen		.120
Fore and aft diameter of pneumatic foramen		.080
Length of pubic bone		1.060
Thickness of stoutest extremity		.140
Length of femur		1.524
Transverse extent of proximal end		.420
" " " condyles		.320
Diameter of middle of shaft		.220
Distance from head to third trochanter		.665
Diameter of head (compressed)		.260

AMPHICŒLIAS LATUS Cope.

Paleontological Bulletin, No. 27, p. 4.

Of the wonderful fauna of the Dakota epoch of the Rocky Mountains the *Camarasaurus supremus* was preëminent in general proportions, the *Amphicœlias altus* was the tallest, and the saurian now to be described, was the most robust. It is represented in Mr. Lucas' collection by a right femur and four caudal vertebræ which are in good preservation. They reveal the existence of another saurian of huge dimensions, and of great mass in proportion to its height.

The caudal vertebræ are apparently from the anterior part of the series. They are all strongly bi-concave; the anterior face more so than the posterior. They all possess diapophyses of depressed form, which take their origin below the base of the neural arch. The centra are short in antero-posterior diameter, and do not present lateral angles. They are composed of not very dense osseous tissue. The anterior zygapophyses are rather elongate, and their articular faces are directed steeply inwards. They are received by corresponding shallow excavations, one on each side of the posterior base of the neural spine. The neural spines are compressed and straight, and become very robust towards the apex.

The femur is extraordinarily robust. The great trochanter is low, but the shaft is widest where it expands outward. The third trochanter is a ridge, is above the middle, and is short and little prominent. It is on the inner edge of the posterior aspect of the shaft, and looks backwards and inwards. The shaft in its present state is compressed so as to reduce the antero-posterior diameter. It is not however crushed or cracked. The condyles have much greater transverse than antero-posterior extent. They are moderately produced backward, and are separated by a deep inter-condylar groove, while the anterior trochlear groove is wide and well marked. The inner condyle is narrowed posteriorly, while the external one is obtuse and robust.

The articular extremity is marked with irregular pits as in *Dystrophæus* and *Cetiosaurus*.

Measurements.		M.
Diameter of anterior caudal vertebra	fore and aft	.150
	vertical	.200
	transverse	.260
Elevation to zygapophyses of the same		.250
Total elevation of the same		.480
Length of femur		1.400
Proximal diameter of femur	fore and aft	.165
	transverse	.410
Distal diameter of femur	fore and aft	.360
	transverse	.450
Diameter of middle of shaft of femur		.280

The caudal vertebræ of this species are much more deeply biconcave than those of the *Camarasaurus supremus;* they also differ in their relatively and absolutely greater breadth of centrum.

TICHOSTEUS Cope.

Paleontological Bulletin No. 26, p. 194 (Published November 21st, 1877).

TICHOSTEUS LUCASANUS Cope.

Loc. cit.

SYMPHYROPHUS Cope.

Vertebral centra moderately elongate, slightly amphicœlous, and composed of uniformly and moderately dense osseous tissue. A narrow deep fossa in the floor of the neural canal. Neural arch coösified to centrum, with a lateral shallow fossa at its base. Neither costal articulation nor process on the centrum.

The coösification of the neural arch of this genus distinguishes it from the few amphicœlous crocodilian genera known from North America, and the fossa at its base is so shallow as to separate it from sauria of the *Pneumatarthrus* and *Ornithopsis* type.

SYMPHYROPHUS MUSCULOSUS Cope.

A vertebra of this species is strongly concave laterally and distinctly so inferiorly. The anterior articular facets plane, the posterior slightly concave. The superficial layer of bone is dense and smooth, excepting near the edges of the articular surfaces, where it is rugose. The rugosity is arranged in a line within the articular faces, and consists of numerous small irregular pits and grooves which inosculate. Near the border the grooves assume a transverse direction. There is a nutritive foramen near the middle of each side of the centrum. There are traces of the neurapophysial suture, showing that the neural arch is distinct in young animals.

Measurements		M.
Diameter of centrum	antero-posterior	.032
	vertical	.027
	transverse	.031

The extremity of a humerus is expanded transversely and displays two unequal condyles, separated by a shallow groove. There are no epicondyles on the external face, but fossæ instead.

Measurements.	M.
Width of distal extremity of humerus	.086
Antero-posterior diameter of larger condyle of the same.	.045

Discovered by Superintendent Lucas near Canyon City, Colorado.

LAELAPS. Cope.

Transac. Amer. Philos. Soc. XIV, 1869, p. 100.

LAELAPS TRIHEDRODON. Cope.

Bulletin U. S. Geol Survey, Terrs. III, p. 805, August 15, 1877.

CAULODON. Cope.

Paleontological Bulletin, No. 26, p. 193, Nov. 21st, 1877.

CAULODON DIVERSIDENS. Cope.

Loc. cit.

CAULODON LEPTOGANUS. Cope.

A second species of the genus *Caulodon* is represented by a single tooth from a locality distant from that from which the *C. diversidens* was derived. Another tooth found with it probably belongs to the same species.

The best preserved tooth possesses the same general form as that of the *C. diversidens*, but the borders of the spoon-shaped crown are thinner and more acute. The convexity of the convex face of the crown does not commence at these edges, but is separated from them by an open shallow groove. There is a median longitudinal swelling at the middle of the length of the concave face. The striking peculiarity of this species is the very small amount of enamel which invests the crown. It is confined to the inner face, and exists there in a thin layer, not more than half as thick as in the *C. diversidens*, which thins out and disappears towards the edges of the crown. Another peculiarity is seen in its absolute smoothness. In *C. diversidens* the enamel, even when polished by use, shows remains of the grooves.

Measurements.		M.
Diameter of crown at base	fore and aft	.015
	transverse	.019
Diameter of crown at middle	fore and aft	.010
	transverse	.021

Found by Superintendent Lucas near Canyon City, Colorado.

COMPSEMYS. Leidy.

COMPSEMYS PLICATULUS Cope.

Paleontological Bulletin, No. 26, p. 195.

EXPLANATIONS OF THE FIGURES will be found at the end of this volume.

On the Palæozoic Rocks of Lehigh and Northampton Counties, Pennsylvania.

By Frederick Prime, Jr., Professor of Metallurgy at Lafayette College, Easton.

(*Read before the American Philosophical Society, December* 21, 1877.)

The Palæozoic rocks of Lehigh and Northampton counties are:
The Potsdam Sandstone (No. I).
The Magnesian or Auroral Limestone (No. II).
The Trenton Limestone (No. II).
The Utica Shale (No. III).
The Hudson River or Matinal Slate (No. III).

The Potsdam sandstone is first found in the outlying peninsula of the South Mountains, known as Lock Ridge, where it occurs on the north-west flank of the hill and undoubtedly has a north-west dip, those dips observed to the south-east being due to a sinking down of the rock at its exposure, where the underlying gneiss has been removed. It next occurs in two small patches on the northern flank of the main range of the South Mountain near Macungie (formerly Millerstown). A small patch of it is also found associated with the gneiss, where the latter crops out through the limestone in the gorge of the Little Lehigh Creek at Jerusalem Church, two miles north-west of Emaus. But it is first seen to any great extent along the north flank of the main range just south of Emaus, where its occurrence is constant, but of varying thickness, and continues for a distance of four and a half miles, after which it can no longer be traced.

It occurs again at the ridge of the South Mountain, close to Allentown, which forms the southern barrier of the Lehigh River, between Allentown and Bethlehem, where the sandstone is about twenty-five feet thick and extends with a few intervals (where it has been cut out by the river) the entire distance between these two places. It also extends across the Lehigh and forms the capping rock of a portion of the gneiss just east of Allentown and north of the Lehigh. The contact between the gneiss and sandstone is distinctly seen about two miles east of Allentown on the Lehigh Valley Railroad track.

The very lowest beds of the Potsdam sandstone are actual pudding-stones, containing pebbles the size of a man's fist and larger, and fragments of red, unaltered orthoclase. The upper beds are composed of a hard, compact quartzite containing greater or less quantities of feldspar nodules, which weather out and impart to the rock a pock-marked appearance. When first quarried the color of this quartzite is blue to bluish-gray, which on exposure soon changes to a dark reddish-brown, due to the oxidation of the ferrous oxide it contains. The change from a pudding-stone to a compact quartzite in the sandstone shows that there has been a gradual sinking of the earth's crust and an increase in the depth of the sea, thus preparing the way for the subsequent deposition of the limestone.

The Potsdam sandstone often, as elsewhere, contains *Scolithus*.

Next above the Potsdam sandstone occur hydromica slates, which Rogers has called the Upper Primal Slates, but which really form a portion of the No. II limestone, and gradually pass into this. They overlie the Potsdam conformably and are far more persistent in their occurrcnce, continuing with few intervals the entire distance from the western boundary of Lehigh county to the Delaware River. They lie along the north flank of the South Mountain and overlie the Potsdam conformably wherever this is visible. They are of great economic importance as carrying the lowest range of brown hematite iron ores, to be mentioned later.

These slates are composed in great part of the mineral damourite and occur of a pink, gray, white. and yellow color. When exposed to the weather they very rapidly decompose to soft unctuous plastic clays in a few days, and some of these will in time probably become valuable in the manufacture of coarse kinds of pottery. Generally they contain more or less of the carbonates of lime and magnesia and silica mixed with the damourite.* Hydromica slate also occurs the greater portion of the distance from the western boundary of Lehigh county to the Delaware River, at the junction of the No. II limestones with the No. III slates, here also carrying brown hematite ores in extensive deposits.

It also occurs intercalated in the limestone, forming layers from the thickness of a sheet of paper to several feet, and these layers are innumerable. Their existence has been seen both in rock outcrops as well as in wells which have been sunk.

The clay to which the hydromica slate decomposes is generally of a white color, although sometimes brown from the presence of hydrated ferric oxide. Analyses would seem to show that the clay contains rather less potash than the undecomposed rock.

Overlying the hydromica slates, and conformable with these and the Potsdam sandstone, is the No. II or Magnesian limestone (Auroral of Rogers), which extends as a great mass varying from six to seven and a quarter miles in width. At four points gneiss crops out through the limestone. These are at Chestnut Hill north of Easton, at a hill two miles north of Bethlehem, the gneiss ridge north of the Lehigh, between Allentown and Bethlehem, and at Jerusalem Church, two miles north of Emaus. Otherwise its continuity is unbroken.

In its lower beds the limestone contains large quantities of chert, forming nodular masses of very various sizes and usually having their longest axes conformable to the bedding of the enclosing rock. This chert occurs in the manner described by Safford† as characteristic of the Knox dolomite of Tennessee. It disappears, however, in the upper strata.

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* Report of Progress for 1874 of Lehigh Dist. Geol. Survey of Pennsylvania, p. 12.

† See *Geology of Tennessee*, by Safford, p. 215, 218.

The limestone varies from a blackish-blue to dove color, being for the most part compact to semi-crystalline, while there are occasionally shaly beds. In composition it varies much, often approaching a true dolomite, again a pure limestone. But from the isolated analyses made it would seem as if the percentage of magnesia was less in the upper beds than the lower ones. The limestone is always siliceous, often very much so, and hence much care is now being taken by many of the iron-masters in selecting beds of it, as a flux in their furnaces, which are low in silica, so as to be suitable for smelting the iron ores of the Great Valley and New Jersey, which are also high in silica. It often contains minute grains of pyrite disseminated through it, which weather out on exposure, leaving minute cavities behind. Numerous analyses have shown the presence of ferrous carbonate varying in amount from 0.538 to 1.305 per cent.

A peculiarity of the limestone is that it is often brecciated, the fragments being composed *exclusively of limestone*, cemented together by calcite or dolomite. The brecciated appearance is rarely visible on fresh fracture, being usually brought to view by weathering. When seen in place it will usually be found that one or more brecciated beds occur between two others which do not exhibit this peculiarity. As the beds of the No. II limestone have been much disturbed by the force which elevated the South Mountain range, the probable explanation of this brecciation is that a very hard, unyielding bed occurs between two more pliable ones; that these, when subjected to the lateral thrust of the uprising mass of the South Mountains, have conformed themselves to the folds of the strata, while the harder one, being unable to do this, has been fractured and *re-cemented in situ* by the percolation of calcareous waters.

Some observers have supposed that the No. II formation is actually composed of two limestones, the lower one belonging to the Huronian, the upper to the Calciferous; and patches of the latter are supposed to overlie the former. The upper limestone (according to these observers) having been formed from the lower, the brecciated limestones are adduced as evidences of upheaval and shore action.

The explanation I have offered of the formation of the brecciated limestone is both more in accordance with the facts observed and with the generally accepted view of the deep-sea formation of limestone than the hypothesis above stated; for the brecciated limestones are as common near the base of the series as the top.

Besides the genus *Monocraterion* found in the Lehigh county limestone belongs to the same family as *Scolithus*, and is therefore no greater proof of age than the latter; and it occurs in but one locality close to the top of No. II, having not more than fifty to one hundred feet from the overlying Calciferous and Trenton.

The fossils thus far found in the No. II limestone do not number a dozen specimens, and have been found in but four localities. At Helfrich's Spring, about two and a half miles north of Allentown, the Jordan makes a great bend around a limestone hill, and, by an underground passage of a portion of its water, has excavated a cave a short distance into it. At the west end of the hill, near the small opening where that portion of the creek forming the spring disappears, there occurs a new species of Monocraterion, as yet undescribed. Of this half a dozen casts have been found; but all efforts to discover the fossil itself have been hitherto unsuccessful. This discovery is the more interesting as the genus *Monocraterion* has hitherto only been known to occur in Sweden.

About half a mile north-east of this five or six specimens of a lingula were found in John Schadt's quarry, but it is impossible to determine its species. About half a mile west of Helfrich's Spring a single specimen of an orthoceratite was found close to the Jordan, just north of Scherer's Tavern, but so imperfect that its species is undeterminable. Finally a specimen of Euomphalus was found on Nero Peters' farm, two miles east of Ballietsville.

Not a single fossil has been thus far found in the No. II limestone of Northampton county.

The No. II limestone, like the Magnesian limestone of the Mississippi Valley, is exceedingly soluble. Streams constantly disappear in the ground, forsaking their original beds except when the volume of water is too great to be carried off by the subterranean channels, and reappearing again as springs at greater or less distances. The effects due to this solution of the limestone are very great. Not only are small sink-holes very common, but beds are found often much contorted locally in a manner which can only be explained by supposing them to have dropped down by their own weight into caverns excavated by the water beneath them. Possibly also the contortion of the hydromica beds as developed in the brown hematite mines at the junction of the limestone with the No. III slates is due to the same action, rendered more prominent by the passage of streams from the slate to the limestone, where the solving action could begin. The different beds too are soluble in very different degrees; some apparently yield at once to the eroding action of water, while others afford a resistance to this operation for reasons as yet unknown, but which are probably rather mechanical or physical than chemical. Knowing as we do so little as to the conditions under which the different layers of limestone, almost or quite identical in composition, were formed, we can only speculate that those layers which resisted erosion were more compact, hard, and dense, perhaps more metamorphosed by a subsequent crystallization than the others, while we actually have no facts on which to base such theories. No better illustration of the darkness amidst which geologists are seeking light can be given than by stating that we are in complete ignorance of the causes which produce different layers of limestone, almost identical in composition, the one above the other. We can explain alternations of shale, sandstone, and limestone by changes in depth of the sea in which they were formed; but such an explanation does not hold good where the same rock continued to be formed. Why should the sediment, whether chemical or mechanical, have formed a continuous layer an inch to several feet in thickness, and then a break in continuity have occurred, to be succeeded by another layer of the same material ?

While the greater portion of the limestone has in all probability been formed in deep water, we have one instance in a quarry in Uhlersville on the Delaware where it must have been formed as a beach, since we find here distinct traces of ripple marks along the entire face of the quarry, some sixty feet high and fifty feet deep, the strata being tilted nearly vertically.

It has been generally supposed that the limestone dips almost universally southward ; and while this view holds good for Northampton county, except at the junction of No. II with the No. III slates and along the north flank of the South Mountains, it is not the case in Lehigh county ; for here we find north-west dips, more especially along an axis which is prolonged some distance into Northampton county, a short distance above Catasauqua.

As a general thing the limestones pass conformably under the No. III slates, and the few exceptions where the slates dip towards the limestones, and the latter away from the slates can readily be explained by an overturning of the beds towards the south, by which means as in the slate quarry close to and south of Ironton the slate apparently passes conformably below the limestone.

Overlying the No. II limestone occurs the Trenton limestone which is more fossiliferous and contains such characteristic fossils as *Chætetes lycoperdon* and *Orthis pectinella* as well as the stems of an encrinite. It was first found about a mile south of Ironton in Lehigh county, then at intervals between Bath and Martins Creek in Northampton county ; but all attempts to trace it as a continuous formation have thus far been unsuccessful owing to the lack of outcrops. It occurs most extensively at Martins Creek on the Delaware, at a point a little south of the cotton mill, and is there as elsewhere apparently conformable with the underlying Magnesian limestone.

This limestone resembles in appearance the No. II, being however more compact and not at all crystalline and of a gray black color.

There has been no apparent sudden break between the two, but the transition has been a gradual one. This was to be expected if the subsidence of the sea-bottom was steady and slow. An examination of the beds between Ironton in Lehigh county and the Delaware River, as close to the junction of the limestone and slate as possible, has shown that the limestone for the entire distance is more or less of a hydraulic one, due to the greater proportion of alumina which it contains. This also was to be expected if the subsidence continued. as signalling an approach to the era of slate-formation and open sea deposition. These limestones are utilized on the Lehigh river in the manufacture of hydraulic cements and lately Portland cement has been made at the Copley Cement Works, which is said to be nearly or quite equal to the imported. Careful search and the demand for it will no doubt cause this variety of the limestone to be explored at various other points in the two counties, and will in time render us independent of the cement now sent from the Hudson River. The limestone is of a dull, earthy appearance, entirely free from any crystalline texture and of a dark grey color.

Before closing our discussion of the limestone it is necessary to speak of the large and numerous deposits of brown hematite iron-ore which occur in it, and which form the main support of the extensive iron furnaces of the Lehigh and Schuylkill Valleys.

The brown hematite iron-ore occurs almost exclusively in two irregular lines of deposition; the one along the northern flank of the South Mountain Range, the other at or near the junction of the No. II limestone with the No. III slates. A few other localities occur, at which the ore is found, but these are insignificant in number compared to the two lines mentioned. Along both these lines the ore is always found either in hydromica slate, or resting on limestone very greatly impregnated with damourite; the same is true elsewhere whenever the brown hematite is found *in loco originali*. Some deposits are however found which have evidently been pockets or cavities in the limestone into which the masses of limonite have been forced together with gravel and clay during the Drift Period. Leaving these out of consideration as of minor importance, let us consider briefly those iron-ore deposits which occur in place. It is at once evident that like the rocks with which they are associated they are of secondary origin, and have been derived from still older formations. The occurrence of the brown hematites with silica, alumina, lime, magnesia, and the alkalies, more especially potash, points to their having been derived from Archæan rocks containing orthoclase and either hornblende or pyroxene. From the decomposition of these three minerals we are able to derive all the oxides above mentioned including the iron which was without any doubt derived in great part from the decomposition of ferrous siliciate present in the hornblende and pyroxene, while a portion of the iron may have been derived from iron pyrites, although this supposition is entirely unnecessary. It is extremely improbable that the brown-hematite was derived from the per-oxidation and hydration of magnetic iron ore, when we recall the great resistance which the latter offers to chemical change of any kind when exposed to the action of air and water, and its unaltered condition and fresh, bright appearance in rivers and on the seashore. But the question as to how the brown hematite got into its present condition and whether it was deposited cotemporaneously with the rocks containing it, or subsequently to these, is still an enigma and various theories have been offered in explanation. For a resumé of some of these hypotheses reference may be made to a recent article by Prof. J. D. Dana, in Vol. XIV, III series Am. Jour. Sci. and Arts, p. 136. The almost entire freedom of the hydromica slate, when fresh, in Lehigh and Northampton counties from ferruginous minerals will prevent our having recourse to pyrite, pyrrhotite, chlorite, garnet, mica and staurolite, which Prof. Dana says occurs in the hydromica region of Connecticut. Hence we must have recourse to other sources. It seems most doubtful that the mineral, from which the brown hematites were derived, was deposited cotemporaneously with the hydromica slates in the district under discussion, since we find the ore often passing through the slate or clay obliquely and intersecting the bedding. It is more probable that the ore was conveyed to its present position by infiltration subsequent to the formation of the hydromica slates. Whence was it derived? I have already stated that the limestone contains varying proportion of ferrous carbonate and of pyrite and when we consider the enormous erosion which the limestone has undergone, the wonder is not that the deposits of iron ore should be so great, but rather that they should be so small. The ferrous carbonate and the pyrite oxidised to ferrous sulphate being both soluble in water, the former when the water contained carbon di-oxide, the waters would naturally carry these salts in solution until they came in contact with precipitating agents such as the alkaline silicates which the hydromica slates carry. These last became converted to carbonates and sulphates, leaving the iron behind, either directly as hydrated ferric oxide, or possibly as ferrous silicates which became later decomposed by the action of ærated water to hydrated ferric oxide and free silica, which latter we now find so universally associated with the brown hematites as quartz. Whatever the origin of these ores may have been, one thing is evident, *viz.*, that there is some genetic relation between the brown hematites and the hydromica slates, as evidenced by the almost universal occurrence of the ore in the slate, extending all the way from Vermont to East Tennessee through the Great Valley as well as in the interior valleys of Pennsylvania where the No. II limestones occur.

It is well here to emphasize the fact that these brown hematite ores all belong to the Lower Silurian limestone formation, since, in 1875, Dr. Sterry Hunt after a cursory examination of Ziegler's Mine in Berks County, situated at the junction of the No. II limestone and the No. III slates, made the mistake, in a paper on "The Decay of Crystalline Rocks" before the National Academy of Science, of supposing that the hydromica slates belonged to the Huronian Period. A mistake into which so eminent an observer as himself would never have fallen had he been better acquainted with the region.

At intervals along the junction of the limestones and slates there occurs a black carbonaceous shale, often decomposed to black or dark blue clay, which I have supposed to be the representative of the Utica shales. It consists of a very carbonaceous hydromica slate (containing damourite), without any fossils and may not belong to the Utica Period at all. In no instance has it been found more than one to twelve feet thick, but it sometimes carries pyrite from which a portion of the iron ores, just mentioned, may have been derived. These shales are of no economic importance.

Overlying these come the No. III, Hudson River or Matinal Slates, which extend into the Kittatinny Mountains. A large portion of these slates are extremely useful for roofing and other household purposes, and extensive quarries have been opened at various points for the purpose of extracting them, as, however, they have been but very slightly examined, during the progress of the present Geological Survey of the State, I shall defer a more detailed description of them to some future time.

Remarks on Professor Prime's Paper.

BY PERSIFOR FRAZER, JR.

(Read before the American Philosophical Society, December 21, 1877.)

The paper of Professor Prime is exceptionally interesting to me because similar, though (as I apprehend him) not identical and perhaps not cōeval, deposits of limonite occur in many parts of the district which I have been studying for four years, and which includes Franklin, Adams, Cumberland, York and Lancaster Counties. The two lines of limonite banks to which Professor Prime refers are also found there, and apparently in analogous position, viz: at the upper and under surfaces of the calciferous formation (but not usually in the latter position when there is no representation of the slates). Besides these two horizons of ore (if the term horizon may be applied to local deposits, in many cases principally produced long after the strata on the borders of which they lie) there are at least several others which cannot be referred either to the top or the bottom of the formation, but at various positions between the two. On the general maps accompanying my report of progress for 1874, there appear to be four or five such lines besides two principal ones nearly converging near Hanover, York County.

This rough conformity of the limonite to the limits of the limestone rock indicates a connection between the two more close than can be attributed to accident.

It has been often repeated before that the greatest exhibitions of iron ore of this character are almost invariably found directly in contact with the limestone, and one would naturally suppose that the cause was to be sought either in the action of one upon the other or in conditions which resulted in evolving both of them. It is true that the position of the clays in all these banks (including the larger ones just referred to), forbids the supposition that the deposits have been entirely produced by infiltration from other points, for, as Dr. Hunt has long ago conclusively shown, there are strings and lenticular masses of iron hydrates, &c., which lie within, and, conformably to the edges of the kaolinized slates, repeating all the convolutions of the latter, and showing other unmistakable signs of contemporaneous history.

Nevertheless, the alteration of the ferriferous minerals which were the origin of these limonite nests has apparently gone forward more rapidly when there was an abundance of carbonate of lime present, than when this rock was represented by the argillaceous and schistose members of the series to which it gives its name.

As to the amount of material necessary to produce all these beds, it might have been much more than furnished by the Pyrite alone, of which we know the former existence by the countless pits and casts which completely permeate the strata; as I endeavored to show several years ago.

In opposition to the chemical hypothesis of the origin of these limonites, it is only just to cite the occurrence at Bull's Run (five miles south of Wrightsville, York County), amongst the calciferous slate, and even the limestone itself, of unusually large Pyrite crystals still in a perfect state of preservation, though under conditions very favorable to metamorphosis. Perhaps the generally gentler dip of the strata at that point protected the pyritiferous layers from the percolation; or perhaps some other cause may account for it; or perhaps the whole idea of the chemical production of limonite is erroneous, though in its support may be mentioned the results of the following experiments:

About 20 grams of crystallized ferrous sulphate were dissolved in 100 c c. of water.

About 50 grams of crystalline limestone were then ground up into fine powder, and placed in a glass stoppered bottle, into which 50 c c. of water was poured.

Ten c c. of sulphuric acid of density about 1.7 were then added, and the contents agitated. After the effervescence had subsided, the iron solution was poured into the same beaker, and the contents again strongly agitated.

After the subsidence of the powdered carbonate of lime, and upon it the light precipitate of calcium sulphate, the liquid was left undisturbed. It gave at first a feeble acid reaction, but later became quite neutral.

From time to time in the course of 24 hours the bottle was shaken, and the sediment again allowed to subside.

A light film of iron hydrate began to be perceptible in a few moments after the first shaking, and was quite perceptible both as a layer above the calcium sulphate, and as a ring which formed around the interior of the flask at the surface of the contained liquid.

This can be observed in the flask which I have brought here, the yellowish brown ring occurring at about the height of the upper surface of 150 c c in this bottle.

It suggested itself that possibly this action might result from the oxidation of the iron solution and precipitation at the surface. To test this the bottle containing the substances above described, was placed in a beaker of about 1.5 liter capacity, and water was carefully poured into the latter so as to overflow and finally submerge the lip of the bottle about 3 cm below its surface, the solution from this time being left undisturbed.

In the course of 24 hours or less there was a very copious flocculent precipitate of iron hydrate in the bottom of the beaker, and on the sloping neck of the bottle while the surface of the fluid was covered with an iridescent film like that on many natural chalybeate waters.

This experiment seemed to show that in presence of limestone the neutral sulphate of iron is readily decomposed in contact with atmospheric air, and the sediment precipitated as a flocculent mass from the upper surface of the fluid.

The reaction of the solution was entirely neutral.

Very little of the precipitate was observed upon the surface of the powder, the rapidity of the chemical change being proportional to the extent of surface in contact with air, and probably to the strength of the solution. The fact that the fluid exhibited no signs of acid reaction is sufficient proof that for every molecule of iron hydrate thus set free one atom of calcium took its place as a sulphate.

To test whether this exchange was effected by the intermediate production of iron bicarbonate, and the decomposition of this at its contact with air, the fluid was examined for carbonates in solution, but none were detected.

It seems probable then that in presence of bodies of limestone and free oxygen, iron sulphate is decomposed and its base precipitated at the expense of the calcium in the limestone.

Another experiment was tried to ascertain the amount of diffusibility of this solution of iron sulphate.

Another beaker of about 1 liter capacity was placed by the side of the first, and filled with water. A piece of large French filtering paper having been rolled up, the ends were immersed in the respective beakers. After standing for 24 hours with the fluid in the beakers at about the same level, the contents of the beaker last employed were tested without finding a trace of iron in it.

A gum tube of about 30 mm. internal cross-sections was then bent, filled with water, the ends stopped by the thumbs, and placed beneath the surface of liquid in the respective beakers.

After two hours of this syphon connection, the contents of the second beaker were again tested without finding any traces of iron.*

In connection with this subject several years ago I sought to explain the chemical reactions involved in the production of limonite by means of limestone in the following four chemical equations from pyrite (though I never have considered it necessary to assume that pyrite was the only ferriferous mineral concerned in this production).

$Fe\,S_2 + O_7 + H_2O$ [in presence of oxygen, water and limestone. $O + H_2O + CaCO_3$]

a. By taking up oxygen and one molecule of H_2O = $FeSO_4 + H_2SO_4$ [Ox, Aq. limestone.]

b. By decomposing 1 molecule of $CaCO_3$ = $FeSO_4 + CaSO_4 + CO_2 + H_2O$ [Ox, Aq. limestone.]

c. By decomposing one molecule of $CaCO_3$ and absorbing 1 molecule of H_2O = $(CaSO_4)_2 + H_2Fe\,CO_4$ [Ox, Aq. limestone.]

d. By oxidation in air (twice the previous) = $(CaSO_4)_4 + H_xFe_2O_y + (CO_2)_2$ [Ox, Aq. limestone.]

It now appears however, that the intermediate stage of iron bicarbonate is not necessary, but that the oxide may be directly produced after the hydroxidation of the pyrite by reaction with limestone in presence of air thus:

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*The same experiment was tried, after the beakers had been connected by a column of water for over a week, with the same result.

$$(H_2O)_3 + O + (FeSO_4)_2 + (CaCO_3)_2 = (CaSO_4)_2 + H_6Fe_2O_6 + (CO_2)_2.$$

In the region which I have studied, it seems to be as difficult to define any horizon or horizons of hydromica slate as to define an horizon of moisture, or of hard and soft rock. Hydromica slate in the counties before named occurs at any horizon, and in all possible relative positions to the limestone. So far as I have been able to judge the relations of these strata to the limonite, they are twofold: 1st, as a carrier of the pyrites, and perhaps other iron bearing minerals, which by their separation from the other constituents have been washed down and collected in the impervious strata *actually* beneath them. 2d, as the material out of which the impervious clays themselves have been produced.

As to the age of these hydromicas, they appear to be represented in the rocks of several ages. There are some which seem to be intercalated with, and therefore of the same age as the limestone itself.

Some are found geologically beneath the limestone and intercalated among the chlorites, quartzites, and orthofelsites of the South Mountain group.

Crystallography in Sculpture.

By Persifor Frazer, Jr.

(*Read before the American Philosophical Society, January* 4, 1878.)

Mr. Spring an artist and a modeler in clay has conceived the ingenious idea of making the human head out of a number of plane surfaces of different area, and he designs these models, less to aid in teaching anatomy than to aid in teaching sculpture.

There are some fifty planes more or less represented on the small models such as this here shown, and of course it is of value to be able to designate each of them by some succinct and comprehensive notation.

It was suggested to Mr. Spring to apply to crystallography for this purpose.

The head here represented is of a high Caucasian type, unless I am deceived, and the symmetry of the features is as striking as their representation by planes is novel.

Of course since a plane represents a certain portion of such variable parts as the flesh, lips, ear, &c., no crystallographic formula would represent the same feature on each of two twins, nor would it represent the same individual in different frames of mind, and states of physical condition, viz.: angry; sentimental; after dinner; after sleep, &c.; nevertheless, a sort of rough approximation to his mean condition will enable if not every man to get his own crystallographic formula, at least that of his race to be expressed.

It must be borne in mind too that the planes here shown are not absolutely correct, but simply an arbitrary series laid on by that most difficult of all persons to calculate exactitudes from — a skillful artist.

In spite of this (and to give the names rather of the things each individual most nearly resembles than what it actually is, and thus aid the student in deriving and placing them), the following attempt was made:

Even with the most symmetrical human face a slight consideration will convince one that the Triclinic System or the System of Pinacoids is the only one which will serve to represent all the planes; nevertheless the zone of macrodemes require a monoclinic habit: and even this fails in many cases owing to a lack of parallel pairs: so that one is obliged to introduce the somewhat crystallographically confusing notion of a single plane.

Yet the general parameter relations of such a plane and the position which it occupies above, below; in front, in rear; right, or left; being indicated by P·, P., ·P, .P for the front (when necessary, adding for the rear P′, $P_{,}$, ′P, ,P) its actual position on the model may be sufficiently well known.

Not that this is not found in nature for some calamine and tourmalines have the peculiarity of being asymmetrical or hemimorphic: and instances of a lower termination of one basal plane and an upper one of a pyramid are not rare.

Assuming the upper trapezoid on the model to be the basal plane or 0P of some triclinic prototype, the following represent some of the principal forms represented:

*m ¯ ∞	upper forehead.	Zone of Macrodomes.
†n $\bar{P}$ ∞	middle frontal.	
†q $\bar{P}$ ∞	bridge of nose.	
r $\bar{P}$ ∞	middle of upper lip.	
s $\bar{P}$ ∞	upper chin.	
t $\dot{P}$ ∞	middle chin.	
u $\bar{P}$ ∞	under chin.	

0 $\bar{P}$	Top of head and plane of nostrils	Basal Pinacoid.
∞ $\bar{P}$ ∞	Front and back of neck	Macropinacoid.
∞ $\breve{P}$ ∞	Side planes of neck	Brachypinacoid.

m·P·	upper skull (4 planes).	Pyramids.
n·P·	upper skull (4 planes).	
q·P·	side frontals and lower occiput (4 planes).	
r·P·	side occiput and middle cheeks (4 planes).	
t·P·	side skull front and above ears (2 planes).	
y·P·	cheeks beside nose (2 planes).	

* Represented also in two occipital planes, 3 in all.

† Represented also in one occipital plane, 2 in all.

∞'P' $\left\{\begin{array}{l}\text{Four of neck planes}\ldots\ldots\\ \text{also cheek by back jaw and posterior skull by}\\ \text{ear}\ldots\ldots\end{array}\right\}$ Prism.

Of course it is understood that m, n, t, r, &c., are simply coefficients by means of which to derive all the forms to which they refer in parameter values from some typical P whose parameter values must be assumed as normal.

The whole object is merely to enable the sculptor to give each plane a name and not entirely an arbitrary one.

On a Series of Chemical Analysis of Siluro-Cambrian Limestone Beds in Cumberland County, Pennsylvania.

By J. P. Lesley.

(*Read before the American Philosophical Society, December* 21, 1877.)

The mixture of magnesia with lime in dolomite rocks has always stimulated and baffled geological speculation, and given birth to opposite hypotheses; some of them, such as that of the issue of magnesium vapors from the interior of the earth, absurd enough; others, such as that recently propounded by Mr. W. L. Green, British Minister at Honolulu, who derives the magnesia from olivine in lava, very suggestive of truth.

I have long felt that no sound basis for speculation had been secured so long as the collection of facts consists merely of analyses of sporadic specimens of limestone and dolomite rocks. I therefore directed Mr. R. H. Sanders, of the Pennsylvania Geological Survey, to make a careful section of the Siluro-Cambrian strata exposed for a quarter of a mile along the west bank of the Susquehanna River, opposite Harrisburg, both by the deep cuttings of the North Pennsylvania Railroad, and by quarries. This was done in connection with his field work in Cumberland County.

Mr. Joseph Hartshorne was also directed to take duplicate samples from every stratum, thick or thin, in this section; one at railway grade, and the other at the top of the exposure (sometimes 30′ high); to analyse them in the laboratory of the Survey at Harrisburg. This he has done, and is still doing, devoting his entire time and attention to the selection of the samples in *situ*, and their determination in the laboratory. In all cases of doubt the analyses have been duplicated and sometimes triplicated; and a report of all analyses as fast as made is forwarded to headquarters.

Of the whole conformable series of beds numbered from the topmost (dipping about 30° to the south) No. 1 down to No 98, Mr. Hartshorne has as yet only analysed from No. 1 to No. 46. But the generalization which the series foreshadows is so interesting and novel that I venture to present it to the notice of the Society, and its correspondents.

Mr. Sanders' report of the beds is as follows:

No. of bed.	Thickness in feet and inches.	Lithological character.
1	3′ 0″	Limestone, light gray.
2	2′ 9″	“ gray.
3	3′ 6″	“ dark blue.
4	4′ 6″	“ dark gray.
5	8′ 1″	“ dark blue, with numerous lenses of flint.
6	2′ 0″	“ dark blue.
7	0′ 9″	“ light blue.
8	2′ 3″	“ light blue; seams of calcite; fault of 13″.
9	2′ 8″	“ dark blue.
10	13′ 8″	“ dark gray; some calcite.
11	5′ 7″	“ dark gray; calcite.
12	3′ 8″	“ gray.
13	12′ 8″	“ gray.
14	4′ 4″	“ dark gray.
15	2′ 9″	“ dark blue.
16	2′ 8″	“ dark blue.
17	1′ 0″	“ light gray.
18	1′ 1″	“ light gray; with calcite.
19	2′ 0″	“ light gray.
20	1′ 2″	“ dark gray.
21	2′ 0″	“ dark blue; with some flint.
22	1′ 4″	“ light gray; with some flint.
23	6′ 11″	“ dark blue; with streaks of flesh colored.
24	0′ 7″	“ light gray; with a great deal of calcite.
25	0′ 9″	“ dark blue.
26	1′ 11″	“ dark blue.
27	6′ 5″	“ dark blue; seams of calcite.
28	4′ 1″	“ light gray.
29	2′ 7″	“ dark blue.
30	1′ 0″	“ light gray; large amount of calcite.
31	3′ 2″	“ dark blue; few veins of calcite.
32	6′ 8″	“ dark blue; few veins of calcite.
33	0′ 10″	“ light gray.
34	1′ 7″	“ dark gray; calcite.
35	0′ 4″	“ dark blue; with white spots.
36	4′ 6″	“ dark blue.
37	0′ 10″	“ light gray; with seams of calcite.
38	4′ 3″	“ dark blue.
39	3′ 2″	“ light gray; seams of calcite.
40	1′ 2″	“ dark gray; seams of calcite.
41	2′ 3″	“ bluish black.
42	0′ 3″	“ bluish black.
43	3′ 6″	“ bluish black; black flint.
44	0′ 10″	“ dark gray; with calcite.
45	0′ 5″	“ light gray.
46	0′ 2″	“ light gray; with calcite.
47	0′ 6″	“ light gray; with calcite.
48	1′ 10″	“ dark gray; black flint.

No. of bed.	Thickness in feet and inches.	Lithological characters.
49	4′ 0″	" light gray; seams of calcite.
50	0′ 5″	" light blue.
51	5′ 2″	" dark blue; few seams of calcite.
52	0′ 11″	" light blue.
53	1′ 0″	" gray; veins of calcite.
54	1′ 10″	" gray; veins of calcite.
55	2′ 0″	" light and dark gray.
56	1′ 10″	" light blue.
57	0′ 10″	" light gray; spots of calcite.
58	2′ 4″	" dark gray; lenses of flint.
59	5′ 8″	" light gray.
60	6′ 4″	" dark blue; masses of flint.
61	1′ 9″	" light gray; seams of calcite.
62	14′ 0″	" dark blue.
63	2′ 10″	" dark gray; much flint.
64	6′ 6″	" dark blue; cleavage planes calcite.
65	3′ 8″	" light gray; full of calcite.
66	4′ 6″	" dark blue; with calcite.
67	5′ 6″	" gray, with a reddish tinge.
68	3′ 7″	" light gray.
69	5′ 0″	" dark blue, with yellow streaks.
70	2′ 3″	" light gray.
71	1′ 2″	" bluish black.
72	2′ 3″	" light gray; calcite.
73	3′ 0″	" dark gray.
74	6′ 0″	" dark blue; some little calcite.
75	5′ 3″	" light gray; seams of calcite.
76	1′ 9″	" light gray.
77	6 3	" light gray.
78	7 3	" light gray, part flesh colored.
79	6 8	" dark blue.
80	11 5	" light gray, streaks of flesh colored.
81	1 5	" light gray.
82	5 9	" dark blue.
83	1 5	" light gray.
84	2′ 5″	" dark gray.
85	4′ 9″	" dark blue.
86	5 10	" very dark blue.
87	6 5	" light gray; full of calcite.
88	17 8	" dark blue.
89	3 9	" dark gray; some calcite.
90	5 0	" dark gray, and flesh colored.
91	8 9	" dark gray.
92	1 2	" light gray.
93	26 6	" dark gray (several beds all alike).
94	5 6	" light gray; calcite.
95	4 6	" dark gray.
96	11 3	" dark blue.
97	8 0	" dark gray.
98	30′ 4″	" dark gray.
	425′ 9″	

This last and lowest bed visible at the north end of the exposure is calculated by Mr. Sanders to lie 1280 feet above the lowest bed of the whole series of Cambro-silurian limestones, or in other words, 1280′ higher in the Palæozoic system than the Potsdam Sandstone. This calculation is made by projecting curves according to all the observed dips between the north end of exposure, and the edge of the slate country to the north, checked by dips in a series of exposures on the east bank of the river. It is not necessary to go here into a discussion of the existence of a great upthrow fault between the limestones and slates.

The topmost bed, No. 1, of the series is therefore 1280′ + 426′ = 1706′ above the Potsdam Sandstone.

The upper limit of the limestones, where they pass conformably beneath the Utica or Hudson River slates, is seen several miles down the river. By projecting dip-curves in the interval Mr. Sanders measures an additional thickness of limestones amounting to 1819 feet.

The total observed thickness of the great limestone formation (No. II of the old Pennsylvania Survey including representatives of Calciferous, Chazy, Birds' eye, Black-river, and Trenton limestones) is 3585′.

The beds selected for examination lie therefore a little below the middle horizon of the mass, and undoubtedly belong to the "Calciferous Limestone Formation" of the New York geologists, the Magnesian Limestone Formation of the Western geologists.

All these beds contain carbonate of magnesia; but while in some of them the percentage of this element is very low, as low as 1% or 2%, it rises in others very high, even to 37%. Some of the beds may therefore be spoken of as pure limestones, and others as true dolomites. The remarkable features however are: 1. That by virtue of some unknown law very few of the beds seem to occupy an intermediate place or exhibit a mixed or moderate character; and 2. That the two extreme types alternate, every other bed being limestone, and every other bed being dolomite.

The astonishing regularity of this law is not so evident to one who merely reads the table of analyses, but unmistakably forces itself upon the attention if the reader converts the table into a diagram. Whether the law rules over the sequence of the whole series of 98 beds is yet to be discovered. Even if it does we cannot safely formulate it as a law determining the distribution of the carbonate of magnesia throughout the 3535 feet of Siluro-cambrian limestones. But such a law, whatever be its restrictions, demands the earnest attention of chemists and geologists.

The following table then gives the percentage of *carbonate of magnesia* in each bed: in column A at railway grade; in column B at the top of the cut, or quarry. Also, the *carbonate of lime*, column C, railway grade, column D, top of cut. Also, *insoluble material*, column E, at grade, column F, at top.

Number of bed.	Carb. Magnesia. A	Carb. Magnesia. B	Carb. Lime. C	Carb. Lime. D	Insol. matters. E	Insol. matters. F
1	36.9	38.3	58.3	57.0	4.6	4.0
2	38.5	3.97	55.6	56.2	5.3	3.8
3	38.1	2.7	56.3	87.6	4.7	8.8
4	1.8	1.9	94.0	97.1	3.8	1.4
5	1.4	0.7	96.4	97.3	1.9	2.1
6a } 6	1.4	1.3	95.5	97.6	1.5	1.0
6b	3.6	3.7	87.1	87.4	9.7	9.0
7	14.5	7.5*	82.3	87.5*	3.1	3.9*
8	24.8	27.1†	68.3	67.6†	5.5	5.4†
9	8.1	8.2	90.7	90.3	1.9	5.7
10	1.8	1.3	97.6	96.7	1.1	2.2
11	32.4	20.0	66.0	75.9	1.6	2.5
12	2.3	1.9	96.8	97.3	1.2	1.4
13	2.4	11.9	95.8	88.9	1.8	3.4
14	4.4	1.0	92.4	97.3	3.4	1.8
15	1.3	2.0	91.8	97.1	1.1	1.2
16	1.1	33.4	97.7	60.1	1.1	5.9
17	1.2	4.3	97.0	93.5	1.3	2.1
18	30.8	34.5	65.3	62.3	3.5	2.9
19	3.0	0.8	96.4	98.7	0.7	0.5
20	18.5	24.3	76.3	71.5	5.3	4.2
21	3.8	1.6	93.7	97.4	1.9	1.3
22	30.8	28.6	65.3	64.3	3.4	6.5
23	1.6	2.0	94.8	93.1	3.9	4.8
24	23.8	23.6	68.9	68.9	7.4	6.3
25	6.8	6.3	90.0	71.0	3.4	22.9
26	28.5	18.1	63.8	75.7	6.2	5.6
27	6.7	2.0	81.3	94.2	12.0	4.0
28	29.1	31.4	65.0	62.4	5.4	5.4
29	1.1	1.5	98.9	97.9	0.6	0.9
30	27.7	25.1	61.0	64.3	10.9	10.3
31	1.7	1.0	96.7	97.6	1.7	1.8
32	1.6	1.2	97.6	96.3	1.1	1.5
33	18.8	25.7	75.2	67.2	4.7	5.9
34	15.0	3.5	81.6	93.6	2.7	2.8
35	17.0	13.3	79.7	83.0	2.9	2.8
36	8.2	1.6	87.7	98.7	1.6	0.3
37	33.6	37.3	61.5	5.63	4.7	6.1
38	1.7	2.2	96.9	95.8	1.4	1.9
39	35.0	34.8	55.6	57.2	6.9	6.5
40	1.3	1.3	92.8	91.0	1.3	7.9
41	22.5	28.2	73.6	6.55	3.4	4.8
42	2.0	——	96.2	——	2.4	——
43	1.7	7.6	97.2	90.1	0.7	1.8
44	29.5	27.1	63.4	68.2	6.4	3.6
45	1.9	2.2	94.3	95.3	3.5	2.2
46	33.2	26.9	57.8	66.2	8.0	5.7
* Bed 7	3d analysis	21.7		72.2		6.3
† Bed 8	" "	30.9		63.6		5.1

*† The third analysis was of a sample intermediate between the top and bottom of the exposure.

The percentage of *Carbonate of iron* in these beds runs thus in the samples taken at railway grade: .... .725 .638 .363
.406 .058 .914 .203 .319 .566 .102
.044 .015 .073 .073 .058 .029 .450
.203 .682 .123 .131 .087 .392 .174
.460 .189 1.189 .290 .696 .058 .219
.363 .110 .885 .653 .580 .479 .725
.479 2.422 .218 .617 .058 .040 1.310
.334 1.438

and the samples at the top exhibit about the same variations within the same limits, bed 16 showing 1.044; bed 39, 1.994; bed 41, 1.523; bed 44, 1.537; bed 46, 1.552, and all the rest falling below one per cent.

The percentage of *Alumina* is extremely low, being *nil* in many of the beds, and .002 .020 .030 .180, rising in four instances to .300 .350 .479 and .600 in the first set of samples, and to .390 in one instance in the other set.

The percentage of *Sulphur* in the first set of samples taken from the bottom of the cuttings is as follows: ..... .048 .050 .044
.119 .070 .050 .032 .058 .076
.028 .589 .042 .034 .027 .018
.040 .095 .088 .076 .025 .106
.016 .095 .089 .065 .069 .017
.176 .095 .081 .128 .150 .080
.048 .133 .130 .141 .051 .072
.071 .115 .059 .092 .035 .071
.096 .096 .075

and in the second set keeps about the same range, but never exceeds .200 except in the *third* (2.50), twenty-seventh (.222), forty-fifth (.307), and thirty-third (.438) beds.

The percentage of *Phosphorus* in the first set is as follows: ....
.006 .008 .003 .013 .006 .trace
.trace .none .008 .trace .006 .014
.006 .015 .008 .003 .trace .003
.011 .006 .006 .trace .trace .trace
.trace .trace .trace .none .none .none
.010 .none .none .005 .none .none
.none .none .none .018 .none .003
.006 .trace .004 .011 .trace .trace

the highest being .018.—In the second set three go up to .010, two others to .013, one to .015, one to .017, and one as high as .061.

The percentage of Carbonaceous matter in the first set ranges as follows :

.094	.012	.472	.166	.128
.090	.250	.152	.150	.098
.124	.128	.050	.208	.138
.076	.040	.040	.020	.036
.010	.016	.160	.060	.130
.030	.590	.123	.200	.018
.268	.082	.100	.266	.208
.086	.054	.032	.060	.288
.trace	.174	.trace	.126	.064
.104	.050			

the highest being .472 and .590.—In the second set the amount of carbonaceous matter rises to .212 (45th bed) .220 (6th *b*) .300 (6th *a*) .450 (28th) .540 (24th).

All attempts to generalize the results must be deferred until the series of analyses shall be completed.

Note.—January 30, 1878. The following additional analyses have been received from Mr. Hartshorne. Bed 6 was subdivided into an upper and a lower portion, although no bed plate subdivision *in situ* could be detected ; solid limestone was seen graduating downwards into laminated limestone, almost a slate. The excess of insoluble materials in 6*b*. over 6*a*. shows the cause of the structure :

6*a*.	3.6	4.0	89.9	92.0	5.7	4.1
6*b*.	8.2	4.1	67.2	66.5	26.6	25.3
47	32.4	31.7	60.4	62.0	5.3	5.1
48	3.2	2.9	92.9	95.7	3.0	1.7
49	31.9	23.7	61.4	68.9	5.3	7.2
50	10.0	7.0	84.1	88.7	4.7	3.4
51	1.3	1.2	98.2	97.9	1.2	0.7
52	10.8	13.4	79.8	79.5	8.6	6.9
53	24.2	23.2	66.9	66.1	7.4	9.7
54	2.4	2.3	91.6	91.0	5.9	6.8

[*Continued from page* 16.]

Meteorological Institute of Vienna, October 1 (96, 88); Astronomical Society of Leipsig, September 17 (99); Royal Academy at Munich, July 1 (97); the Wurtemburg Union at Stuttgardt, August 1 (95, 96, 97 and 98, returning also duplicates); the Victoria Institute, September 15 (99); Statistical Society, September 27 (99); and M. M. Barcena, Mexico, September 29 (97, 98, 99).

Letters of envoy were received from the R. Swedish Academy, June, 1877; R. Bavarian Academy, July 1, 1877; and Cambridge Philosophical Society.

Donations for the Library were received from the Imp. Academy of Russia; R. Swedish Academy; R. Danish Society; R. Observatory at Prag; Geological Institute and Anthropological Society at Vienna; the German Geological Society at Berlin; the Societies at Bremen, Giessen, Görlitz, and Stuttgardt; the R. Observatory and R. Academy at Munich; the Vaudoise Society and M. Henri de Saussure, and M. F. W. C. Trafford; the Geograph. and Anthropological Societies, Academy of Medicine, Museum of Natural History, Annales des Mines, Révue Politique and M. Hugo, of Paris; Physical Society at Bordeaux; Natural History Society at Bordeaux; Academy at Brussels; Victoria Institute; R. Geographical, Zoological and Antiquarian Societies, and London Nature; Cambridge Philosophical Society; Canadian Journal, Toronto; Essex Institute; Prof. O. C. Marsh; Penn Monthly; Medical News; American Journal Med. Sciences; Mr. Geo. E. Emory of Lynn, Mass.; Botanical Gazette, Ind.; and the Meteorological Observatory at Mexico.

An obituary notice of the late Vice-President, John Chapman Cresson, was read by Mr. Fraley, followed by remarks and reminiscences by Mr. Roberts.

A communication entitled: "On Land Plants in the Silurian of N. A., and on a Fungus discovered in the Coal Measures of W. Pennsylvania. By Leo Lesquereux," was read by the Secretary.

On motion, the Secretaries were authorized to print the 8° plate, accompanying the memoir, drawn and published in the Proceedings.

Dr. Cresson communicated the analysis of a specimen of coal from Pulaski county, Va., which he exhibited and discussed with other members present.

Prof. Chase announced that at the request of Mr. Hall he had sought and found a harmonic series which exactly adapted itself to the radii of the observed orbits of Deimos and Phobus, to the radius of Mars, and to the centre of oscillation in Mars, and gave the correspondence of the theoretical and observed numbers on the black board.

Permission was given the Secretaries to report their Coal-slack advertisement at the next meeting.

Pending nominations 839, 840, 841 and 842 were read, and 839 ballotted for.

On scrutiny of the ballot boxes the election of Mr. W. B. Taylor, of the Patent Office, Washington, D. C., was announced by the Chairman.

Stated Meeting, November 2, 1877.

Present, 16 members.

Vice-President Mr. Price in the Chair.

A letter accepting membership was received from Mr. Wm. B. Taylor, dated Washington, D. C., October 26, 1877.

Letters of acknowledgment were received from the New Zealand Institute, Wellington, September 7, 1877 (Trans. O. S., I to VI; N. S., I to XIV, and XV, i. ii.; Proc. VIII to XVI, except No. 96); from the Lond. Soc. of Antiquaries, October 9, 1877 (99); and the R. S. Edinboro', October 13, 1877 (99).

A letter of envoy was received from the Central Physical Observatory at St. Petersburg, September, 1877.

A letter requesting No. 88 was received from the R. Institution' of S. B., dated October 11, 1877. On motion the request was granted.

A letter requesting information concerning the publications of the Society previous to 1876 was received from F. Leypoldt, N. Y.

Donations for the Library were received from the R. S. New S. Wales; Gen. Stone of Cairo; Met. Obs. Dorpat; Soc. at Ulm; Révue Politique; R. Ast. S., and London Nature; Dr. E. Jarvis, Mass.; A. Antiq. S. Worcester, Mass.; Water Department of Philadelphia; Mr. C. W. Hart; Prof. E. D. Cope; Internat. Medical Congress; Mr. S. H. Scudder, and the U. S. Coast Survey.

Prof. Cope exhibited a number of fine teeth and other remains of Triassic vertebrates, found by Mr. Wheatley at his copper mines near Phœnixville, and laid on the table for publication in the Proceedings " Descriptions of extinct Vertebrata from the Permian and Triassic formations of the United States, by E. D. Cope, a part of which was a MSS. record of remarks made by him August 17, 1877. The descriptions in the paper apply to the following new names:

Palæoctonus appalachiensis,
" *aulacodus*,
Clepsysaurus veatleianus,
Suchoprion cyphodon,
Belodon caroliniensis,
Cricotus gibsonii,
" *discophorus*,
Lysorophus tricarinatus,
Diplocaulus calamandroides,
Strigilina gurleiana,
Ctenvolvus pusillus,
Orthacanthus quadriseriatus,
and
Archæobelus vellicatus.

Professor Marsh inquired what authority the Society assigned to the dates of publication affixed to its extra copies of papers in the Proceedings distributed by their authors, and how such dates were fixed, urging the importance of established and well understood rules for the government of the practice in such cases.

After much discussion, it was, on motion of Mr. Lesley,

> "*Resolved*, That the Secretaries be directed to use, in case of separata or extras, and at the foot of the last page of the same, the phrase 'Printed (such a date)' viz: the date of the day of the completed printing of each memoir."

The Secretary read an imperfect list of fossils collected by Mr. C. E. Hall, Palæontologist of the Survey of Pennsylvania, at Harvey's Five Points, in Westmoreland county, Pa., from a horizon in the Lower Barren Coal Measures, about 300′ below the Pittsburgh Coal and therefore about 2000 feet above the supposed or presumptive top of the Chemung Formation, one of which appears to be *Streptorhyncus Chemungensis*, var. *arctostriatus* of the Chemung Group in the State of New York (see N. Y. Pal. Vol. IV. p. 71), and another, *Ambocœlia umbonata*, var. *gregaria*, does not seem to differ from that found in the Chemung of New York, yet occurs here in great numbers, and in some cases composes almost the whole mass of the rock. These fossils are accompanied by a *Streptelasma* too imperfect to be specified, and by undetermined species of *Chonetes*, *Productus*, *Athyris* and *Cardiomorpha*.*

Professor Frazer made some preliminary remarks upon a hitherto unnoticed trap dyke extending for miles through Lancaster county, in Pennsylvania, into or towards the Welsh Mountain. Its importance arises from the fact that it passes through the Nickel Mine, and through the North Valley Hill, of assumed Potsdam sandstone.

Pending nominations Nos. 840, 841, 842 and new nominations Nos. 843, 844, 845, 846, 847, 848, 849 and 850 were read.

An application for the Coal-slack Premium from John R. Peters, M. E., of Dover, Morris Co. N. J., was received through Mr. Briggs, and referred to the Committee on that subject.

A form of advertisement suggested by Mr. Fraley to the Secretaries was referred to their consideration.

Mr. Briggs, who objected to certain expressions, moved the following resolution, which was referred to the Board of Officers, after the word "approved" had been struck out with the consent of the mover.

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* See note p. 280.

Whereas the American Philosophical Society at its meeting on November 11, 1866, passed the following resolution:

Resolved, That the Board of Officers and Council be authorized to offer a premium of Five Hundred Dollars for any successful process by which Anthracite Coal Dust may be economically utilized, such premium to be competed for and awarded in such manner as the Board of Officers and Council may designate, and the premium if awarded to be paid out of the accumulated income of the Magellanic Premium Fund, and

Whereas, the American Philosophical Society as custodian of the Magellanic Fund as well as in its character as a Scientific Institution should take every precaution that the premium, if granted, should be given to such person or persons as may establish their right to the same, both on the merits of their claim and by their title as claimants, therefore

Resolved, That the Board of Officers and Council be requested to designate the manner of the competition and award for the instruction of the Committee and of the several applicants in the following regards:

1st. As to the process—Where a claim is based on any alleged invention or discovery, the priority or originality must be proved to be with the claimant to allow him to be considered entitled to the premium.

2d. As to the successful process—When the claim is founded upon the introduction and bringing into general public use well-known processes, the commercial or mechanical importance of which have heretofore been unappreciated, the instrumentality of the person or persons claiming, in effecting the result will be investigated, both as regards other claimants, if any, and also as against others who may not have applied for the premium in order that the premium may not be awarded in default improperly.

3d. As to economical utilization—It must be proved to the satisfaction of the Society that the particular process on which the premium is claimed, shall not only have operated successfully as a process both experimentally and in practice, but shall have so utilized anthracite coal dust as to have given a merchantable value to the same in the general markets for anthracite coal, or shall have demonstrated the economic substitution of dust for other coal in so large quantities as to materially aid the manufacturing industries of the country.

4th. The Board of Officers and Council are also requested to so regulate the conditions of the award that by no possibility any allegation of favoritism can be made, should the premium fall to a member of the Society.

The form suggested by Mr. Fraley and referred to the Secretaries, reads as follows:

"Mr. John E. Wootten having claimed the premium of five hundred dollars offered by the American Philosophical Society for a successful process for utilizing the waste material commonly known as coal dust, and a Committee of the Society having reported that his process is successful and meritorious, notice is hereby given that the Society will award such Premium to Mr. John E. Wootten on the Friday in February, 1878, unless before that date satisfactory proof shall be given to the Society that the process of Mr. Wootten has been invented and successfully put in use by other parties prior to the date of his patent therefor.

"Such proof must be in writing and be filed before February 1, 1878, with the undersigned, one of the Secretaries of the Society, at the Hall, No. 104 South Fifth street, Philadelphia.

"Insert in two daily papers a week for six weeks."

The Treasurer having announced to the Society that $4,000 of the United States 5-20 loan had been called in—On motion, it was

Resolved, That the Treasurer of the Society, J. Sergeant Price, be authorized under the seal of the Society, to sign the necessary transfer of the $4,000 U. S. Loan called in by the Government, and receive the proceeds thereof.

Resolved, That the Treasurer be authorized to re-invest the proceeds of the U. S. Loan about to be paid off under directions of the Finance Committee of the Society.

The following letter to the Curators respecting the Peale Collection was laid before the Society:

ACAD. NAT. SCIENCE, PHILA., October 25, 1877.

Hector Tyndale, Esq., Charles M. Cresson, M.D., Curators of the Amer. Phil. Society.

GENTLEMEN :—I have had the pleasure to receive your communication of the 18th inst., authorizing the transfer of the Peale Collection of relics of the Stone-age to the custody of this Academy, on condition that the said collection shall be returned to the American Philosophical Society on demand.

After the transfer has been made a receipt for the collection will be given.

Very respectfully,

W. R. W. RUSHENBERGER,
Pres. Acad. Nat. Sci. of Phila.

And the meeting was adjourned.

Stated Meeting, November 16, 1877.

Present, 16 members.

Vice-President Mr. FRALEY in the Chair.

Visitor Mr. Hendricks.

A letter was received from the Academy of Natural Sciences of Philadelphia, announcing that they had received "a Collection of specimens of the Stone Age of the Human Race, as collected and arranged by Franklin Peale," deposited by the American Philosophical Society in the Cabinet of the Academy, upon condition of being returned on demand.

Letters of acknowledgment were received from the K. K. Ast. Obs. Prag, October 18, 1877 (95, 97, 98); R. Obs. Brussells, October 19, 1877 (Trans. O. S. 6 Vols; N. S. I, II, III, V, X to XIII, and Proceedings Nos. 7, 13, 62, 96, 98, 99); R. Geological Soc. of Ireland (99).

A letter was received from D. H. Scheffler, dated Braunscheig, September 25, 1877, asking permission to make a donation to the Library of his work on Physics, the first two parts of which were lain upon the table.

Donations for the Library were received from the Mining Bureau, Melbourne; F. Holmgren, Prof. Phys. Upsal; Prussian Academy; D. H. Scheffler; Flora Batava; Geographical Society, Annales des Mines, Révue Politique, Paris; London Nature; Boston Nat. Hist. Society; Am. Journal S. & A.; Acad. Nat. Sciences, Franklin Institute, College of Pharmacy, Med. News, Penn Monthly, Philadelphia; U. S. War Department, and Engineer's Dept. U. S. A. Washington; and the Meteorological Observatory at Mexico.

Mr. Eli K. Price read the first portion of a paper on Sylviculture. See page 197.

Proceedings of the last meeting of the Board of Officers and Council were submitted.

Pending nominations Nos. 840 to 850 were read.

Mr. Fraley reported the receipt of the quarterly interest on the Michaux Legacy, due October 1st, and its payment to the Treasurer.

Dr. Cresson offered the following resolution:

Resolved, That the Curators be directed to make arrangements for the deposit of the collections of Mexican, Peruvian and other Relics belonging to the Society in the Academy of Natural Sciences, under agreement that the said collections shall be returned on demand.

The motion was seconded and agreed to.

Prof. Frazer offered the following resolution:

WHEREAS, The prosecution of certain lines of original research simultaneously by a number of able observers has led to confusion as to the authors of specific names to whom the merit of discovery should be assigned, and

WHEREAS, There seems to be a difference of understanding the term publication, and

WHEREAS, It is earnestly desired by the workers in the above-mentioned fields that the date allowed to a description of a species should be as soon as possible after the discovery which that description implies, therefore

Resolved, That this Society will accept as the date of the discovery of a species the date at which a careful and comprehensive abstract of such discovery or discoveries shall have been published in any public journal or magazine,

Provided, That the terms of the abstract shall sharply and distinctly define what has been discovered, and how far these discoveries may be considered by their author to affect scientific questions, and

Provided, That no additions or modifications of such abstract be permitted.

On motion, the above preamble and resolution were referred to the Secretaries.

And the Society was adjourned.

Stated Meeting, December 7, 1877.

Present, 11 members.

Vice-President Mr. **FRALEY** in the Chair.

Letters of acknowledgment were received from the R. S. New S. Wales, Sydney, October 12 (96); K. K. Geol. R. Vienna, November 4 (99); Royal Ast. S., London, November 12 (99); Radcliffe Observatory, Oxford, October 4 (99); and Dr. Siemens, Westminster, S. W. London, September 27 (97, 98, 99).

Letters of envoy were received from the K. K. Hoffbuchhandlung, Wien, Graben 27, October 30, asking exchanges; N. Gesell, Freiberg i. B. August 8; the Batavian Society, Rotterdam, May, 1877; and the Holland Society at Harlem.

Donations for the Library were received from Mr. John

Tebbut, Sydney; K. K. G. R. Vienna; K. K. Hof, Vienna: K. P. Acad., and D. Geol. G. Berlin; Meteor. Obs., Dorpat; the Societies at Halle, Freiberg i. B., Harlem, Rotterdam and Leeds; R. Institute at Venice; Révue Politique; London Nature; R. Asiatic Society; R. Geog. Society; Met. Com. R. S.; Yale College; College of Pharmacy; and E. D. Cope; U. S. Coast Survey; Mexican Observatory; and Editors of Gazeta Cientifica at Venezuela, Caraccas.

Mr. Price continued the reading of his paper on Sylviculture.

Mr. Blasius read a communication on the cause of the loss of the U. S. ship Huron. See page 212.

Mr. Blasius postponed the reading of another paper, entitled "Modern Meteorological Method" to the next meeting.

The Treasurer's Annual Report was read.

Pending nominations Nos. 840 to 850 were read.

The following Report of the Secretaries on Prof. Frazer's Resolutions was read:

"The Secretaries having considered the Resolution offered by Prof. Frazer, November 16, 1877, respectfully report that in their opinion the action of the Society at a recent meeting, ordering the Secretaries to cause the date of each paper published in the Proceedings to be printed at the foot of the page, is sufficient for all purposes respecting the right of priority to authors of said papers and that no further action need be taken by the Society.

In explanation of this report a letter from Dr. LeConte was read, referring to the printed Rules of Nomenclature adopted by the Entomological Club, Cambridge, July 3, 1877, and papers by Dr. LeConte published in the Canadian Entomologist, October, 1874, and November, 1874, entitled "On some changes in the Nomenclature of North American Coleoptera," &c., and "On Entomological Nomenclature."

The consideration of the subject was, in Prof. Frazer's absence, postponed to the next meeting.

The following is the text of the letter:

Illness prevents me from being present at the meeting of the Society this evening, and I must therefore write what I wish to say in favor of the report of the Secretaries upon the resolutions offered by Prof. Frazer, at the last meeting.

The definition of what constituted a proper publication of a generic or specific description of an organic form is a question which concerns naturalists alone (i. e. botanists and zoologists), and is not properly a subject to be dealt with by any other class of men of science.

It is, moreover, a question to be determined in the interests and convenience of science alone, and in such manner as to promote its progress by investigators, without reference to the supposed honor of discovery, personal property in the name, or any other of the selfish generalities, under which bad and hasty work are too often covered, and subsequently excused.

The subject has occupied the serious attention of the most eminent naturalists in all countries for many years, and there is likely to be with patience and mutual forbearance among the extremists, an accord of feeling, to be arrived at within a short time.

To show the extremely cautious manner in which it has been approached by societies and persons devoted exclusively to but a single branch of zoology I append the report of a committee of the entomologists of the United States and Canada upon nomenclature, which has progressed to its present form only after two years of active correspondence and consultation. The Secretary will have the kindness to read the appropriate portion of the report. I send too a copy of a short essay by myself, asking attention to a marked passage on p. 205, as embodying in a condensed form my convictions of the motives with which every investigator in science should labor for the best interests of the department of knowledge he has chosen.

"*It is the privilege*, with the facilities for publication now afforded by learned societies, of every careful observer of nature to contribute valuable material for the progress of the branch of science which he is capable of cultivating. *It is his duty* to put his contributions to knowledge in such a form as to be most easily available to his brothers in science. Whether his name remains connected permanently with his observation or not is a matter of small importance; he has done his duty in increasing the power of work of his colleagues."—*Canadian Naturalist, p.* 205.

For these reasons and for many others, which I might specify if time permitted, I think it would be most inexpedient for the Society to express an opinion upon what may constitute a proper scientific publication of supposed new genera and species.

J. L. LECONTE, *Secretary.*

PHILADELPHIA, Dec. 7, 1877.

P. S.—I have received within a few days a pamphlet from Mr. J. Putzeys, of Brussels, which exemplifies both his courtesy to other investigators in the same field, but also the care with which European Societies will guard any attempt to take advantage of the facilities for publication afforded by them. The pamphlet in question is a laborious and conscientious monograph, containing descriptions of one hundred and eleven species, of which 66 are new. This memoir *is to be* published in the Stettiner Entomologische Zeitung for 1878, and the separata of the author, though in his hands for distribution before the middle of November, 1877, bears the same date,

1878. Let this most venerable and time-honored Society err, if there be error, rather on the side of courtesy, than sanction in the slightest degree indecent struggles for priority in giving names to but partially recognized and vaguely studied objects.

The Secretaries reported the following form of advertisement ordered by the Society:

"The American Philosophical Society hereby offer a premium of five hundred dollars for the best successful process by which Anthracite Coal Dust may be economically utilized, the said premium to be competed for and awarded after due examination and report by a Committee appointed for the purpose. Applicants for this premium are requested to file with this Society, within three months, the proofs: 1st of the originality of their inventions, and 2d, of the successful practical working of these inventions. All applications to be sent to the Hall of the A. P. S., 104 South Fifth street, Philadelphia."

"J. P. LESLEY."

This advertisement was, on motion of Mr. Price, adopted and ordered to be published once a week for four weeks in the Scientific American.

On motion of Mr. Price it was

Resolved, That 1000 extra copies of the address on Sylviculture be printed for distribution, out of the Michaux income.

On motion of Mr. Price it was

Resolved, That $40 be appropriated out of the Michaux income to purchase a copy of Michaux & Nuttall's American Sylva for Fairmount Park Library to be presented to the Commissioners of Fairmount Park for the use of the Landscape Gardener.

And the meeting was adjourned.

Stated Meeting, December 21, 1877.

Present, 18 members.

Vice-President, MR. FRALEY, in the Chair.

Mr. H. Phillips, Jr., a newly elected member, was introduced to the presiding officer and took his seat.

Letters of acknowledgment were received from the Vienna Geographical Society, Nov. 22 (97); Physical Society at Geneva, Sept. 15 (96, 97, 98); Central Bureau of

Statistics, Stockholm, Sept. 24 (96–99); and Prof. Rokitansky.

Letters of envoy were received from the Verein für Erdkunde, at Halle an der Saale, Nov. 18, asking for exchanges. On motion this Society was placed on the list of correspondents to receive the Proceedings.

Also from the Physical Society at Geneva, Sept. 15; Central Bureau of Statistics, Stockholm, Sept. 24; Meteorological Office, London; and the U. S. Coast Survey.

A letter was received from the Royal Institution, G. B., Albemarle street, London, Nov. 22, acknowledging the receipt of Proc., No. 88, and asking for the completion of their sets of Proceedings and Transactions of the A. P. S., which on motion was granted (Proc. 69, and Trans. N. S. Vols. III to XI, inclusive, and XIV, ii).

The report of the Secretaries on Prof. Frazer's resolutions made at the last meeting, was on motion, concurred in.

Prof. Prime read a paper "On the Palæozoic Rocks of Lehigh and Northampton counties, Pa." See page 248.

Prof. Frazer followed with remarks on similar rocks in his district of York and Adams counties, and exhibited some artificial brown hematite iron ore in the form of a precipitate from pyrites.

Mr. Lesley exhibited, in illustration of one of the subjects of Prof. Prime's paper, some fine crystals of calcite enclosed in shells of brown hematite, obtained by Mr. Joseph Revere, of Canton, Mass., from a magnesian limestone cave back of St. Genevieve, below St. Louis, Missouri.

Mr. Blasius read his postponed paper on Modern Meteorological Method; and referred to another on certain meteorological facts and problems discussed by him at meetings of this Society.

Mr. Blasius called attention to the gradual adoption of his views by prominent meteorologists without proper acknowledgment of their indebtedness. Some of those views were promulgated as long ago as 1851. He had taken especial pains to publish them and to circulate them by private correspondence with other workers in this field of research, so that there seemed to be no excuse for any attempt to withhold the recognition which is his just due. He had repeatedly pointed out defects in the present prevailing methods of weather-study. Recent papers in scientific journals and discussions before learned bodies had shown that the same investigator could draw entirely opposite conclusions from the same set of observations.

His reclamation was meant to cover the frequent effect of rain in increasing the force of storms; the influence of the uneven distribution of heat, both in vertical and lateral directions; the mingling of cold and warm air through the alternate encroachment of polar and equatorial currents, the former passing under, or the latter flowing over its antagonist; the consequent occurrence of high barometer storms as well as of low barometer storms; and the fact that the areas of both high and low barometer are parts of the same storm.

He had aroused the attention of meteorologists to the fact that dangerous storms not only might be both preceded and followed by rain, but might be wholly unaccompanied with rain; and these new views had entirely changed the character of the published official and unofficial weather reports and predictions; but he especially insisted on the fact that the methods of observation and correllation in regard to storms, employed by professional meteorologists were still so defective that any hypothesis whatever could be constructed from the present weather charts, at the will or fancy of a meteorologist who had no better resource of his own in the shape of facts of his own observing.

Dr. Sadtler read by title two papers entitled, "A new method for the decomposition of chromic iron," and "Precipitation of copper and sodium carbonate." By Edgar T. Smith, Ph. D., Assistant in Analytical Chemistry, University of Pennsylvania. Being contributions from the Laboratory of the University of Pennsylvania, No. XII. See page 216.

Mr. Lesley exhibited a diagram of the railway cutting, opposite Harrisburg, in Cumberland County, showing the altitude and order of forty-six (46) consecutive layers of the Magnesian Limestone Formation, No. II (calciferous auroral, or siluro cambrian); and a colored diagram of the analysis of said beds, made by Mr. Joseph Hartshorne, in the Laboratory of the Second Geological Survey at Harrisburg, exhibiting a remarkable regular alternation of magnesian and non-magnesian layers, with maxima of insoluble matters corresponding with the maxima of carbonate of magnesia. See page 260.

Prof. Cope displayed life size drawings of vertebræ, femoral and other bones of gigantic fossil saurians of the genera Lamarasaurus, and Amplicœlias (*Camarasaurus supremus*, *Amplicœlias altus*, and *A. latus*), and gave their detailed descriptions in a paper entitled:

"On the Vertebrata of the Dakota epoch of Colorado. By E. D. Cope," with two others: viz. (see page 193).

"Descriptions of New Vertebrata from the Upper Tertiary formations of the West. By E. D. Cope;" (see page 219).

"On some saurians found in the Triassic of Pennsylvania by C. M. Wheatly. By E. D. Cope;" (see page 231).

Prof. Frazer exhibited two framed plaster casts of the Arms of Lord Baltimore, restored from half destroyed sculptures on the mile stones of Mason & Dixon's boundary line between the States of Pennsylvania and Maryland.

The Report of the Finance Committee was read and the recommendations contained therein adopted.

On the recommendation of the Finance Committee in their report, the following resolution was adopted, viz:

Resolved, That the Committee of Finance be authorized and directed to take the needful steps for the sale of the French rentes now held as an investment for the Michaux Legacy and when the proceeds are received into the treasury to make an investment thereof here in such securities as are designated by law for the investment of trust funds.

Pending nominations 840 to 850, and new nominations 851, were read.

And the meeting was adjourned.

NOTE TO PAGE 270.—Prof. Stevenson in a private letter dated January 15, 1878, writes that in the Crinoidal Limestone of the Barren Measures *Spirifer planoconvexa* is characteristically abundant, and has the same mode of occurrence in the rock, which *Ambocoelia umbonata* has in the Chemung, but should not be mistaken for it.

ERRATA for Proceedings A. P. S. Vol. XVI. No. 99.

On page 624, line 12, *substitute* "that of the Sun, and the light received from it 75 times that received from A 61 Cygni, we obtain the following relations:" &c.

On page 625, line 25, *for* "fact of" *read* "fact that."

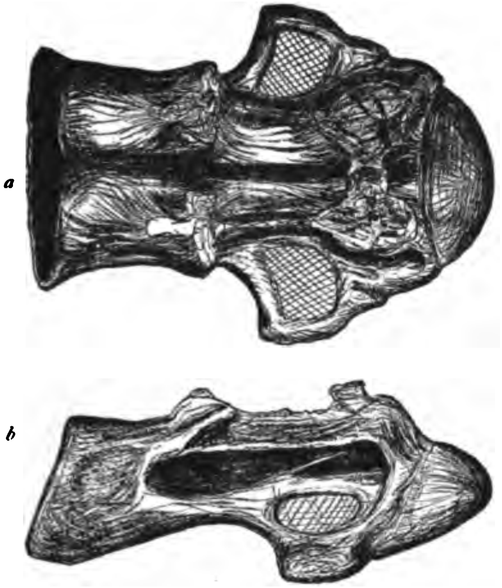

Fig. 1—Cervical vertebra of *Camarasaurus supremus.* *a* from above; *b* from right side. The neural arch is mostly wanting. These figures, like all the others in this paper, are one-tenth natural size.

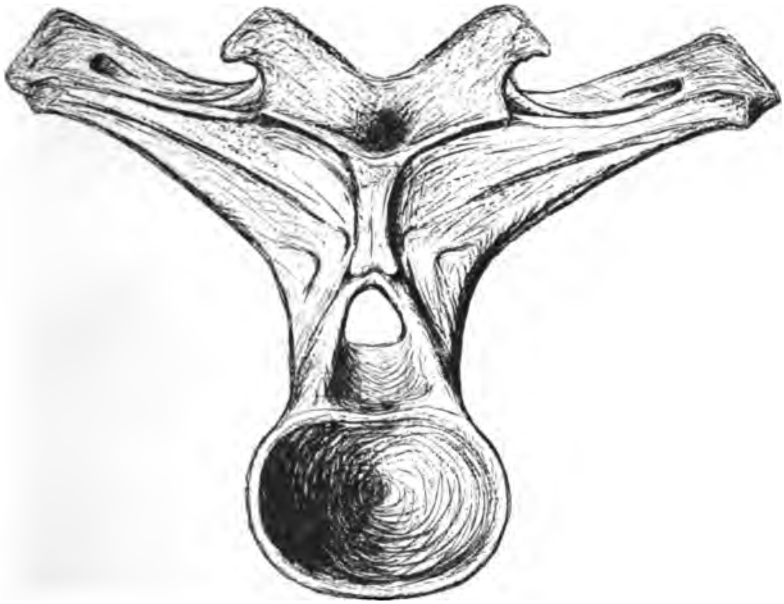

Fig. 2—Anterior dorsal vertebra of *Camarasaurus supremus* from behind.

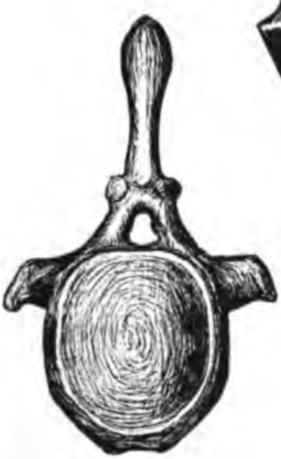

Fig. 4.

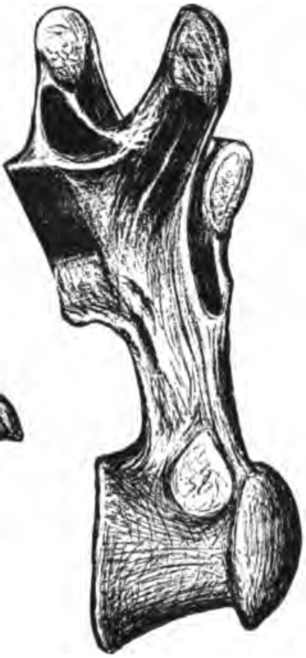

Fig. 3.

Fig. 3—Dorsal vertebra represented in Fig. 1, the right sight side. Fig. 4—A caudal vertebra viewed from behind.

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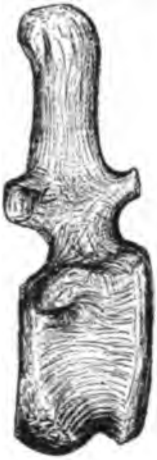
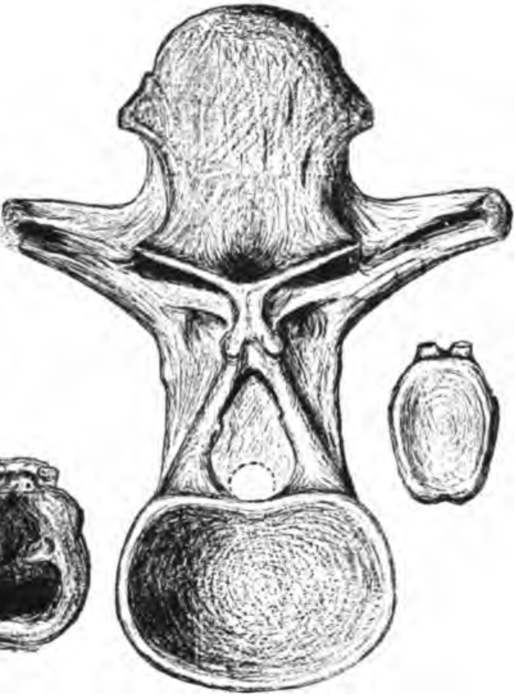
Fig. 7.





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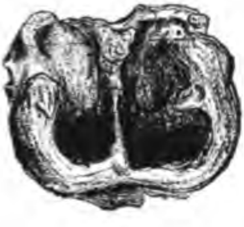


Fig. 6.

Fig. 5.

Fig. 5—A median dorsal vertebra seen from behind, showing the hyposphen. Fig. 6—Centrum of a dorsal vertebra without anterior wall. Fig. 7—Caudal vertebra shown in fig. 4, from the right side. Fig. 8—A more posterior caudal, end view of the centrum.

OF

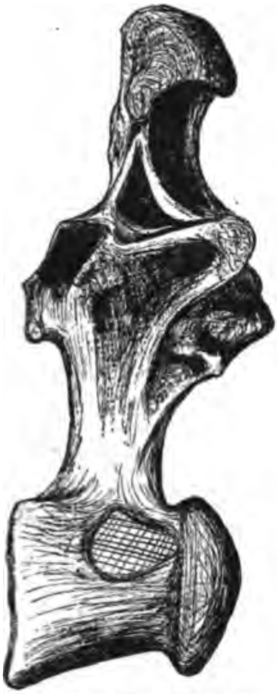
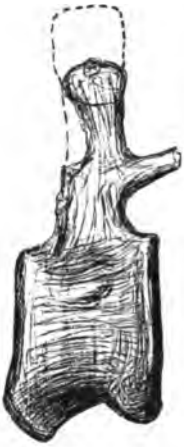
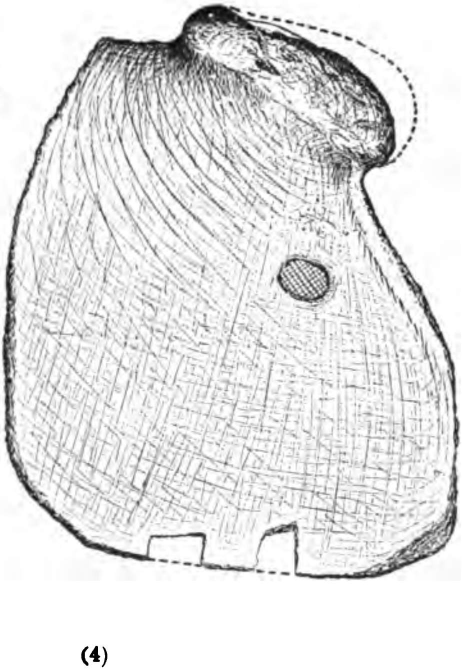
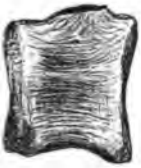


Fig. 9—View of the right side of the dorsal vertebra of *Camarasaurus supremus*, represented in Fig. 5.







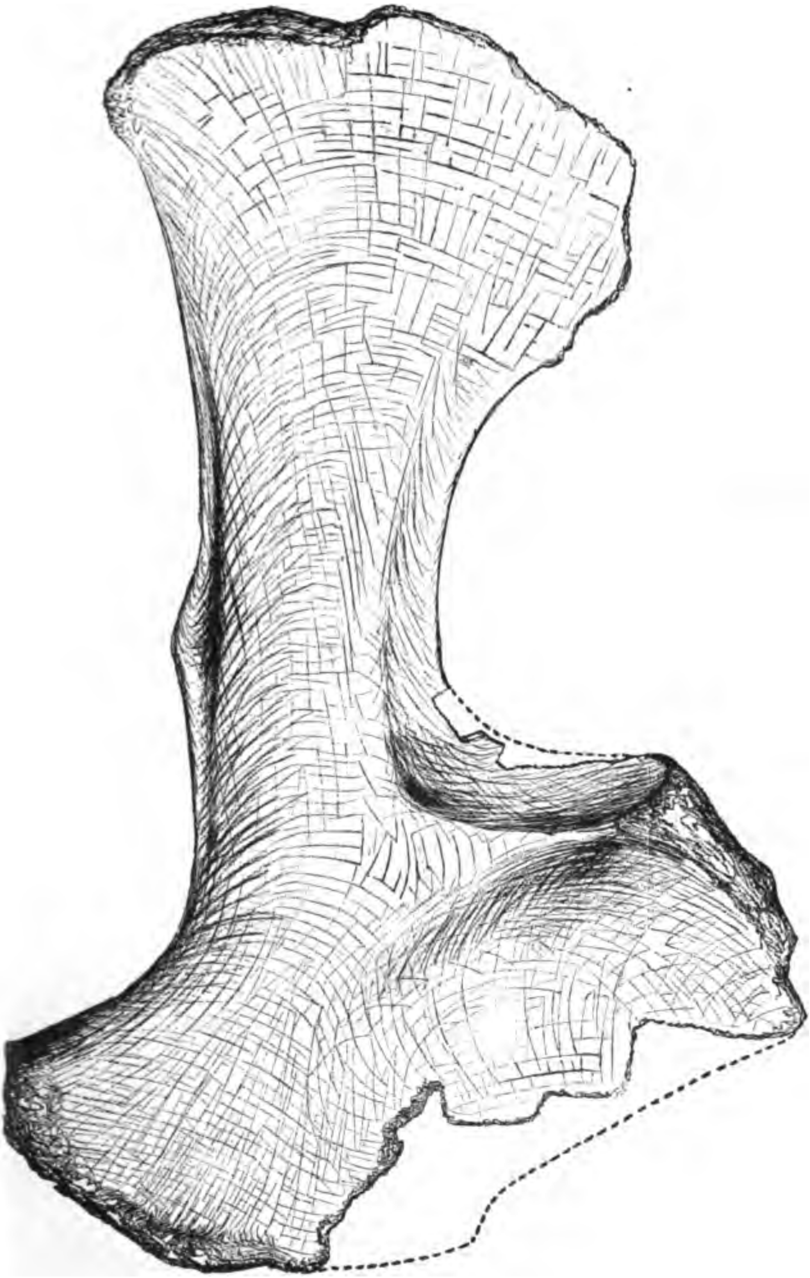


Fig. 10—The right scapula of *Camarasaurus supremus*, external view, $\frac{1}{10}$ natural size.

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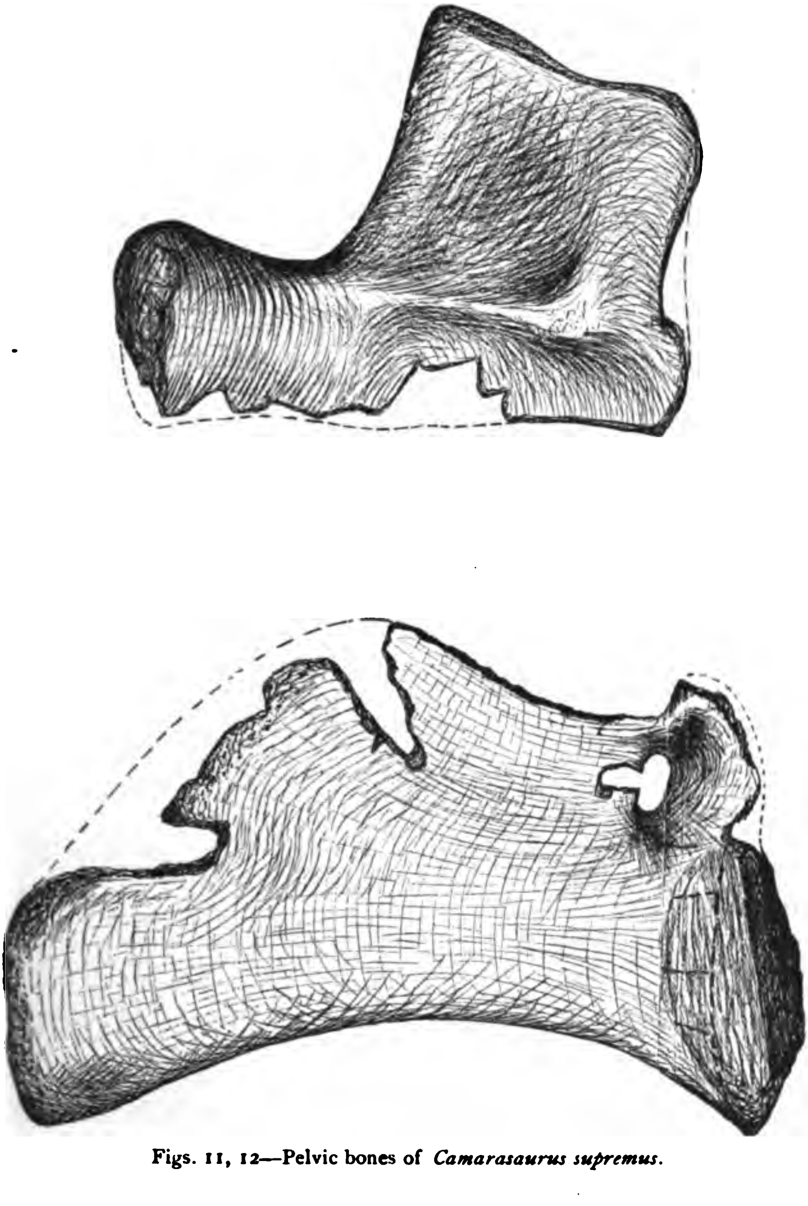

Figs. 11, 12—Pelvic bones of *Camarasaurus supremus*.

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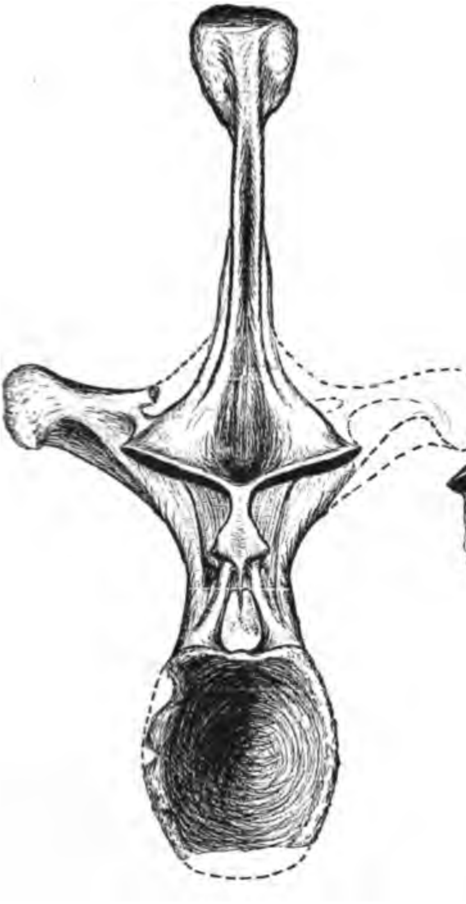

Fig. 13.

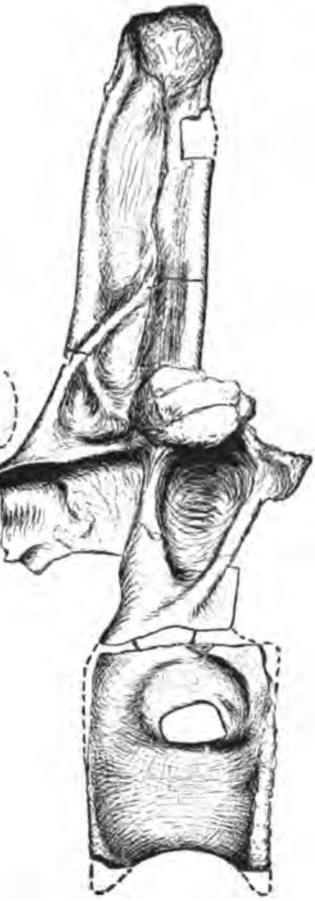

Fig. 14.

Fig. 13—Dorsal vertebra of *Amphicœlias altus* seen from behind, exhibiting the hyposphen.

Fig. 14.—The vertebra represented in Fig. 13 seen from the right side, displaying the excavations of the neural arch and spine, and the pneumatic foramen of the centrum.

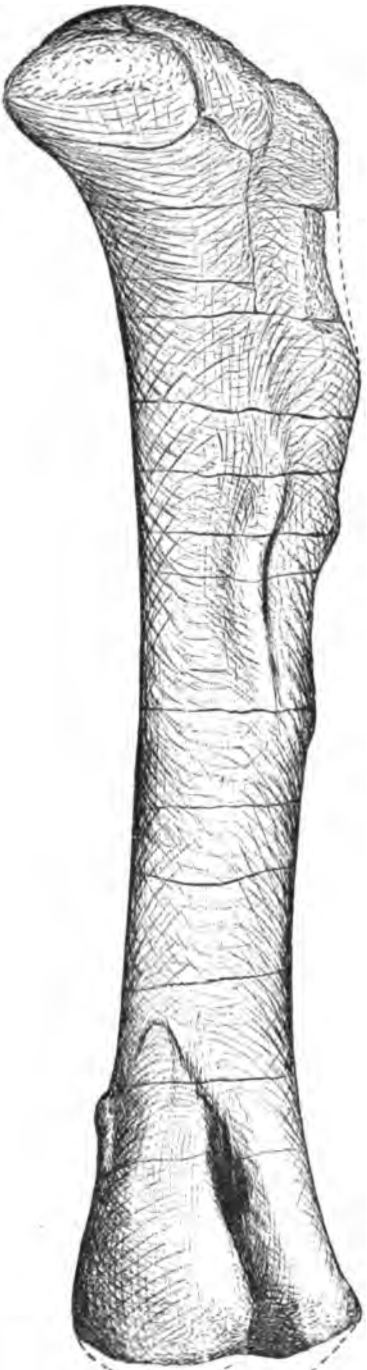

Fig. 15—Femur of *Amphicælias altus*, seen from the inner posterior direction.

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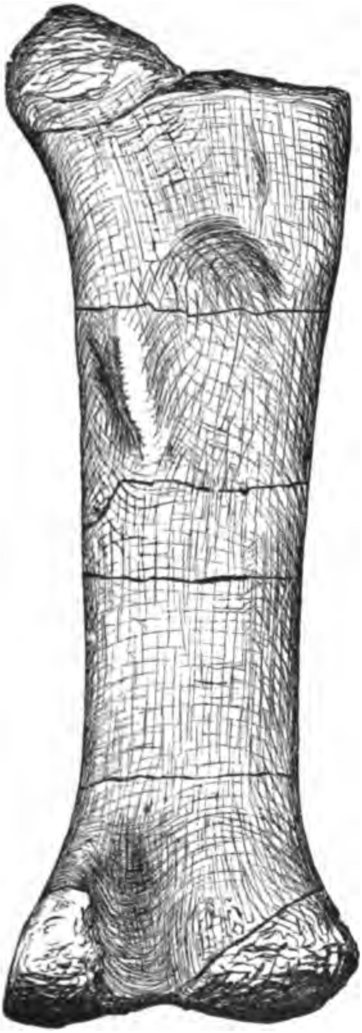

Fig. 17—Left femur of *Amphicœlias latus*, from behind.

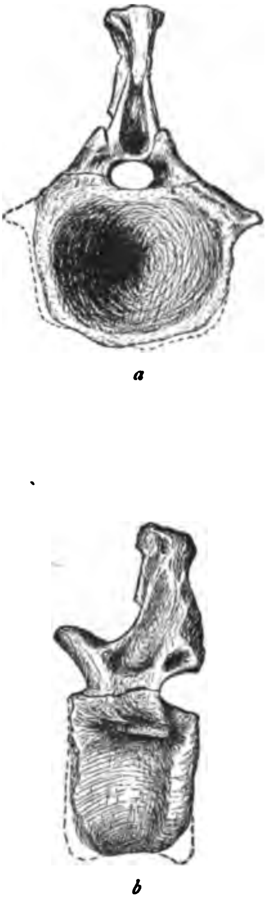

Fig. 16—A caudal vertebra of *Amphicœlias latus*; *a* from before, *b* from the left side.

PROCEEDINGS

OF THE

AMERICAN PHILOSOPHICAL SOCIETY,

HELD AT PHILADELPHIA, FOR PROMOTING USEFUL KNOWLEDGE.

VOL. XVII. JANUARY TO JUNE, 1878. No. 101.

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(*Continued on 4th page of Cover.*)

Stated Meeting, Jan. 4, 1878.

Present, 10 members.

Vice-President, Mr. E. K. Price, in the Chair.

A letter of acknowledgment was received from Prof. Oswald Heer, dated Zurich, Dec. 13, 1877 (99).

A letter of envoy was received from the Botanical Garden at St. Petersburg, Nov. 10, 1877.

Donations for the Library were received from the Asiatic Society of Japan, Yokohama; the Academies at St. Petersburg, Munich, and Madrid; the Art Union at Ulm; the Geographical Society; Bureau of Longitudes; Annales des Mines, and Revue Politique; the Royal Astronomical Society and London Nature; American Academy, and Natural History Society at Boston; Silliman's Journal; New York State Library; College of Pharmacy; Leo Lesquereux of Columbus, O.; Commissioner of Agriculture at Washington; Botanical Gazette, Ind.; and M. Michel Chevalier of Paris.

The report of the judges of the annual election was read, by which it appeared that the following officers were duly elected for the ensuing year:

President.

George B. Wood.

Vice-Presidents.

Frederick Fraley, Eli K. Price, E. Otis Kendall.

Secretaries.

John L. LeConte, Pliny E. Chase, George F. Barker, J. Peter Lesley.

Curators.

Hector Tyndale, Charles M. Cresson, Daniel G. Brinton.

Treasurer.

J. Sergeant Price.

Councillors for three years.

Daniel R. Goodwin, W. S. W. Ruschenberger,
Henry Winsor, William A. Ingham.

A letter was received from Mr. Moncure Robinson, stating that he had received from M. Chevalier, a copy of the last report of the Permanent French Committee to the Association for the construction of a submarine railroad between Calais and Dover (M. Chevalier being President of the French, and Sir John Hawkshaw, President of the English Association) for transmission to the American Philosophical Society, as a donation to the Library. Mr. Robinson expresses his high appreciation of the report, and appends to his letter a translation of it into English, made at his request by Mr. J. Percy Keating, for the gratification of members of the Society.

"PHILADELPHIA, DEC. 28, 1877.

"*J. P. Lesley, Esq., Secretary of the American Philosophical Society.*

"SIR:—I received early in November, from Mr. Michel Chevalier, the distinguished political economist and statesman, now President of *the French* Association, for the construction of a submarine railroad between Calais and Dover (Sir John Hawkshaw being President of the English), two copies of the last reports of the Permanent French Committee to the Association. These copies were transmitted me by Mr. Chevalier, accompanied by the request, that I would present one of them in his name, to the American Philosophical Society, of which he was elected a member in 1852, and of which honor he desired to present this evidence of his recollection. On reading the copy sent for myself, I was struck with the beautiful lucidity of the remarks of Mr. Chevalier, on the '*present condition of the undertaking.*' They are in fact so clear, as to enable the general reader, if only moderately familiar with the French language, to appreciate correctly, even without the advantage of the accompanying maps and reports, the favorable features, as well as the difficulties and dangers of the enterprise. It seemed to me, under the circumstances, desirable to transmit with the reports of Mr. Chevalier and his distinguished co-laborers, a translation in English of the address of Mr. Chevalier, in presenting them to the Association, and I should have made myself a translation of this address, but for the kindness of a highly accomplished young friend, Mr. J. Percy Keating, of this city, who volunteered to make one for me, and who I was satisfied would execute the task much better than I could. The translation has been sent me within a few days past, and I now transmit it with the reports, for the gratification of members of the Society, who may desire to know the views of Mr. Chevalier, in regard to the submarine railroad, but find it less irksome to read or listen to them in their mother tongue than in the French.

I avail myself of this opportunity to express my regret that though I have been for a much longer period than my friend Mr. Chevalier, a member of the Society, I have so far written nothing that seemed to me worthy of presentation and of preservation in their records. I am not, however, the less sensible on that account, of the compliment paid me in 1833, when I was elected one of its members.

Respectfully yours,
Moncure Robinson."

Railway under the English Channel. Address of the President, M. Michael Chevalier. Translated by Mr. J. P. Keating, of Philadelphia.

(*Read before the American Philosophical Society, Jan.* 4, 1878.)

Gentlemen: We have deferred until to-day calling you to a general meeting from our desire to render ourselves competent to furnish you with information requisite for the solution of a problem traced out for us in our laws themselves, and which may be this way stated.

Is a submarine railway between France and England practicable without encountering extraordinary difficulties involving immense expenditure?

We desired that the studies to which we have applied ourselves ever since the passage of the act allotting the work to us, should be pushed so far as to enable us in this meeting to give you an idea of the nature and character of the material to be traversed in order to effect the subterranean passage from one shore of the Channel to the other.

It was our duty, moreover, to examine if its stratification was continuous, without presenting fissures or crevices in any appreciable number, or in any menacing proportions, whereby the sea water could penetrate into the works. It was no less interesting to know whether the bed of the intended tunnel was in its composition sufficiently impermeable to guarantee us from any irruption of the great masses of water which are alike our greatest obstacle and our greatest danger.

The work of the year 1876 has been devoted, like that of 1875, to the most minute explorations, both of the surrounding region of country, and of the bed of the Channel itself. These explorations, carried on conformably to the most approved methods, and with every care which science could suggest, have afforded a mass of results which it was necessary, in order to render them available, to group together, and mark out distinctly in sundry plans and charts. These plans, containing all that is essential to the subject matter, have been distributed among you. You have also received reports, to the number of four, in which are set forth the different methods of exploration that have been pursued. In these reports the conclusions derived from the studies are strictly deduced, and you are thus enabled to judge whether the conclusions are satisfactory.

The work of exploration during the year 1876 was much more extensive than that of 1875, and consisted as follows:

First, In the study of the coasts bordering the sea, both in France and in England, and upon which each stratum of the material which constitutes them is easily distinguishable. This study of the coast naturally involved the geological examination of a zone more or less extended of the shore itself.

Secondly, In a study of the bottom of the Channel so thorough as to enable us to draw a geological chart almost as exact as if the water had retired and its bed were left perfectly dry. This study was pursued by means of multiplied soundings in the sea, each one of which is marked upon the large map annexed to the reports which you have before you. It was proposed to conduct these operations in such a manner that the instrument at each sounding, beside indicating the depth of the water, should bring to the surface a sample of the rock forming the bottom of the sea. All these depths obtained, varying with the tide, have been modified by calculation so as to be reckoned with reference to a uniform level.

Finally, We have constructed on the shore at Sangatte, a shaft which has been sunk to the depth of 130 metres; that is to say about twenty metres below the well-known clay subsoil which plays an important part in the geology of this region. Upon this clay lies the whole of the stratum composing what geologists call the cretaceous formation, and which interests us particularly. Being impermeable, this bed of clay secures the lower layers of chalk from any uprising of the waters which are to be found on a still lower level. It is designated in the reports by the English name *Gault*.

Of the three operations just enumerated, which have all been brought to a successful termination, the second, to wit, the study of the Channel with the design not only of making a hydrographical examination, but of drawing a geological chart of the bed of the sea, was the most delicate and the most complex.

We do not hesitate to assure you, gentlemen, that this portion of the work of 1876 has been accomplished in a very superior manner. We do not believe that a work of hydrography and geology combined has ever been executed, carrying with it such certainty of result. These are merits which the authors of the reports, who were also the authors of the studies pursued, have not in any way sought to bring to notice, but to which we regard it our duty to call your attention.

These divers explorations were organized and directed by the delegated member, Mr. Lavalley, who was enabled upon this occasion to show to what extent he is familiar with all the problems, however great or small, which may present themselves in public works. It is to him particularly that we owe the definite shape of the instruments designed for the deep sea soundings, which have proved so efficacious. To him also are we indebted for the ingenious arrangements that enabled us in the season of 1876 to accomplish with perfect exactness and great rapidity the extraordinary number of soundings which we deemed indispensible in order to render ourselves sufficiently acquainted with the geology and hydrography of the Channel. The co-laborers of Mr. Lavalley, in 1876, were Mr. Larousse, late hydrographical engineer of the National Marine Corps, and Messrs. Potier and DeLapparent, engineers in the National Corps of Mines. All three by their zeal, their intelligence, and their devotion to a difficult task the national importance of which they fully appreciated, have entitled themselves to the consideration of the learned world, and to your gratitude.

We propose to give you in some detail the principal results of the three classes of operations above mentioned, and to this end it is only necessary to sum up the reports which have been addressed to you. These reports, let me add, are eminently worthy of your attention, and if you will read them in extenso you cannot but approve of them.

I. *The study of the two coasts.* The study of the shores of the Channel proves that the geological formation is very much the same throughout that part which particularly concerns us, comprising the chalk formation. The same layers are found on the two coasts, of the same character, and what is remarkable, having the same thickness. Hence, the presumption, corroborated by other circumstances, that formerly in a prehistoric age, instead of an arm of the sea separating the two shores, there existed a continuous surface of ground, more or less undulated, between the points where since have arisen the towns of Calais and Boulogne on the one side, and Folkestone and Dover on the other. The Channel, in such a hypothesis, would be due to the continual erosion of a soil of little consistency, as is usually the case with the chalk formation, this soil having yielded by degrees to the shocks of the waves of the Northern Ocean ever violently agitated during the stormy season. From this circumstance we derive the hope that the strata to be met with beneath the sea, and through which the tunnel would pass would be as a general thing continuous, and present, if any thing, deflections merely, to which the track of the subterranean railway might conform without much inconvenience.

This hope is substantiated by the fact that on both sides of the Channel the layers of clay forced from the horizontal position in which they must originally have lain, have not been very much displaced. Throughout the greater extent of the Channel on the French side it is a seventh merely, a fact which would appear to indicate that the subterranean commotions which caused the deviations in the layers from the horizontal plane were not of much moment.

II. *Geological chart of the bed of the Channel.* This portion of the studies pursued is worthy of increased attention. At first sight it seemed an insoluble problem, for in almost every region of the earth the bottom of the sea consists of sand and gravel, covering to a great or even remarkable depth the massive rocks that cling to the solid body of the planet. In the Channel of the Straits of Calais, however, runs a current at the rate of about two or three knots an hour, which sweeps away the sand and gravel as it is deposited, and does it the more effectually, from the circumstance of its being quite narrow, and of a depth of not more than 30, 40, or 50 (53 at most) meters. The rock being thus laid bare throughout a large portion of the Channel, it is easy by multiplying the soundings to reach it frequently with the lead. Then by attaching to the lead a steel tube, sharpened at its end, we have the means of bringing to light every time the lead falls, a small cylinder of the material cut out of it. Success is the more assured if the bottom from which the cylinder is to be extracted, be of a comparatively soft substance, as is in fact the case with the different layers of the cretaceous formation.

This state of things and these circumstances, so favorable to our enterprise, had been already revealed by the experiments of 1875, when, notwithstanding the rudely constructed apparatus, and the small and inconvenient steamboat, 1523 soundings had been made, 753 of which had brought to the surface samples of the material beneath. In 1876, sufficient time having elapsed to enable the mode of operation, and the preparations incident thereto, to be brought to the greatest possible perfection, and when a steamboat was provided, offering all the desirable conveniences, 6,148 soundings were made, 2,500 of which furnished little cylinders cut from the bottom. This makes in all, for the two years, 7,671 soundings, and 3,267 samples, of which some however had no scientific value.

In the same lapse of time the operations were twice as many in 1876 as in 1875. The little cylinders thus extracted from the bottom of the Channel, the character of which was perfectly determined by means of a geodesical examination made at the time by Mr. Larousse, were each labeled and enclosed in a vial. They were afterwards examined by the practised eye of our geological engineers, Messrs. Potier and DeLapparent, who, not content with the mere evidence of the senses, frequently had recourse to the precise indications of chemical analysis. They were thus enabled in the majority of instances to ascertain to what special layer of the cretaceous formation the samples belonged, and in this way the geological chart was traced out step by step.

From the very outset we had felt convinced that the success of a submarine railway depended absolutely upon the tunnels' being placed in the chalk formation. In this particular we were in full accord with the English engineers, who, like ourselves, were occupied with the idea of a junction of France and England by means of a submarine railway, and who had even preceded us in their explorations, carried on upon the same system as ours on both sides of the Channel. Outside the cretaceous formation we would find a species of rock either very permeable to water, such as the green free stone, or of great relative hardness.

Chalk has the advantage of being easily perforated; but this cretaceous formation is in this respect by no means equally satisfactory throughout. There is a marked difference between the upper and lower layers. The upper layers, consisting chiefly of a white chalk similar to that worked at Meudon, near Paris, contain more or less water. The lower layers present qualities much more satisfactory to the engineer, whether he have to cross or to remain in them. We have had occasion to note this difference frequently in France, where the working of the most productive mines of the North and of the Straits of Calais has obliged us to sink numerous shafts through the cretaceous formation. The result of a long experience acquired by the coal miners is that the upper layers contain what are called the *niveaux*, subterranean sheets of water, the draining of which is very expensive. The miners, in sinking the shafts, consider their difficulty at an end when once they have reached the lower layers known among them as *dièves*, elsewhere called *Rouen chalk*. In the greater number of instances, these layers have been found to contain very little water, and may therefore be considered practically impermeable.

It happens at times that among these same layers some that are on a higher level are crossed by fissures through which part of the water contained in the upper beds finds its way. These waters, as they descend, meeting the lower and more compact layers of Rouen Chalk, can penetrate no further, and accordingly gush forth into the open air wherever they find an issue. This it is which gives rise on the French coast to the sources of the Cheu d'Escalles, and in England to those of the Lydden Spouts. But the volume of water of this description, which would be found in excavating the tunnel, would be such as could easily be drained by pumps, thanks to the great power which our modern exhausting machines have acquired; and no alarm need be felt on that account.

It being, therefore, evidently to our interest to place the submarine railway as much as possible in the *dièves* or Rouen Chalk, our engineers then applied themselves to the task of computing the space which these layers occupy in that part of the submarine rock which is accessible to us; as also the degree of regularity which they present.

The result of their labors affords good ground for the belief that throughout the whole width of the channel, except in the neighborhood of the two shores, the Rouen Chalk, or lower stratum of the cretaceous formation, is of remarkable regularity, so much so, indeed, that it would be possible to lay the submarine railway almost in a straight line through it, and at a very ordinary depth. At a short distance from the French coast, where the Quenoc rocks are to be seen, and also in proximity to the English shore, on the reef of Varne, the upheavals of the earth are found by our engineers to have caused a deflection in the layers, but without severing them.

It does not appear that there exists elsewhere throughout the whole width of the channel, at least in the part which concerns us, a single break which might be considered an essential obstacle. Indeed, the study of the layers comprising the Rouen Chalk even suggests the practicability of so constructing the tunnel as to enable us to enter this particular formation in France, and to reach the open air in England without having ever quitted it.

The only objections which might be brought to bear against this idea with regard to the whole length of the line, comprising the approaches from the mainland to the sea, would be such as might be drawn, for example, from the position of certain spots considered more available for a connection with the railways coming the one from Paris and the other from London. Reasons such as these might, indeed, have some weight.

But apart from considerations of this character, it would be to our advantage, if only on principles of economy, to retain the roadbed wholly within the Rouen Chalk from the place where it descends into the earth in France, to where it emerges into the open air in England.

One circumstance of great importance to us is that the total thickness of the Rouen Chalk is in the neighborhood of sixty metres. As our tunnel would not require more than ten metres for its construction, this would give us ample room to conform to any of those deviations from a straight line in the course of the strata which are more or less common in the interior of the earth, especially since in the present instance, as we have seen, these deviations are of no great consequence. If perchance in order to preserve the previously determined level, we were forced to abandon the shelter of this formation, it would only be for short intervals, and the difficulty would be by no means insurmountable.

III. *The Shaft at Sangatte.* This shaft had for its object to prove the water bearing character, on the one hand, and the relative dryness, on the other, of the different layers of this cretaceous formation. A very simple means was made use of in measuring the quantity of water which the different layers furnished. You will find the account of it in the special report upon this subject. The result was that as soon as the Rouen Chalk was reached the quantity found was exceedingly small.

The present advanced stage of our studies enables us to fix the position of the shaft designed for the removal of the material extracted during the work of excavation, and to mark out the direction of the gallery which will conduct the leakage waters to the shaft. The first thing, then, to be attended to would be the sinking of the shaft, followed by the excavation of the gallery. This latter would be placed in the same stratum with the tunnel, and excavated to the distance of about two kilometers, would serve the purpose of a supplementary reconnaissance of the route to be taken by our enterprise. You are aware that on the part of England explorations have been made even prior to our own, having the same object in view. They were under the supervision of Sir John Hawkshaw, a distinguished engineer, with whom we have entered into relations. From the very beginning he most obligingly made known to us not only the results of his operations, but the mode, as well, by which he had effected them, and gave us, at the same time, models of the instruments he made use of. Our intercourse with him has been of great service to us. We have just transmitted to him the results of our labors during the year 1876, and Mr. Lavalley, the delegate, has repaired to London to confer with him with regard to the definite direction of the tunnel.

These conferences which have brought to light much valuable information from both sides, and have evinced, likewise, that perfect spirit of accord so much to be desired in similar undertakings, will shortly re-open

With the well-known character of Sir John Hawkshaw and the good will which we shall bring to every discussion, well knowing that in this manner we can best fulfill your wishes, the coming conferences cannot fail of excellent results.

We have also to confer with the Railroad Company of the North with regard to the point where our line should join theirs, the decision, of course, to be subject to the approval of the general government.

We continue to have nothing but praise from the administration. They have never ceased to encourage our enterprise. We have just received from them a despatch intimating the Minister's desire to see our works in active operation as soon as possible.

Mr. Fernand Raoul-Duval, the member of the sub-committee who has special charge of the accounts, will make our financial condition known to you. It is very satisfactory. He will also submit for your inspection and approbation a statement of the expenses incurred during 1876.

Since our last meeting, Mr. Cézanne, engineer of bridges and highways, who was a member of the subcommittee, has been removed by premature death from his family, his friends and our Association, so greatly indebted to him for his very many services.

Mr. Talabot having determined from the necessity of increased care of his health to send in his resignation as member of the permanent committee, we have expressed to him our deep regret on being deprived of the co-operation of one so eminent.

On motion of Mr. S. W. Roberts, the thanks of the Society were tendered to Mr. Chevalier, and the MSS. as translated referred to the Secretaries.

The death of Dr. Jared P. Kirtland, Dec. 10, 1877, aged 84, was announced by the Secretary.

Prof. Frazer presented a communication on the cranial planes in a model bust, prepared by Mr. Edward A. Spring, of Perth Amboy, based on a study of the Venus of Milo. The planes belong to the triclinic system.

Prof. Frazer reported the results of an experiment intended to illustrate his views of the formation of limonites.

Mr. Lesley was nominated for Librarian.

Mr. J. S. Price offered the following resolution which was seconded and adopted:

Resolved, That the Treasurer, J. Sergeant Price, be authorized to receive from and receipt to the City of Philadelphia, for the sum of one thousand dollars ($1000), being the amount of City Loan belonging to the Society, falling due January 1, 1878.

Resolved, That the Treasurer be authorized to invest the proceeds of said loan under the direction of the Committee on Finance.

And the meeting was adjourned.

Stated Meeting, Jan. 18, 1878.

Present, 15 members.

Vice-President, Mr. E. K. PRICE, in the Chair.

Dr. T. B. Reid, a lately elected member, was introduced to the presiding officer and took his seat.

A letter of envoy was received from the Royal Observatory, Greenwich, London, S. E., Dec. 27, 1877.

A letter requesting the continuance of exchanges and the completion of a set of Transactions A. P. S. was received from the Linnean Society of Bordeaux, dated Dec. 30, 1877.

Donations for the Library were received from the Ed. Revue Politique; M. Melsens; the R. Belgian Academy; Ed. Nature; Leeds Phil. and Lit. Society; Canadian Naturalist; Cornell University; Philadelphia Academy of Natural Sciences; Pharmaceutical Association; Franklin Institute; Penn Monthly; Medical News; American Journal Medical Sciences; Prof. E. D. Cope; Mr. Henry Philips, Jr.; Mr. Lorin Blodget; Ed. Robinson's Epitome of Literature; Bureau of Education and Engineer Department, Washington; Ed. Western Inventor, Cincinnati; and Ministerio de Fomento, Mexico.

The death of Benjamin Hallowell, of Sandy Springs, Md., and also

The death of Thos. F. Betton, of Germantown, was reported on the occasion of the stated annual reading of the list of the surviving members of the Society.

The death of Marcus Bull, formerly of Philadelphia, and of Theodore Mommson, of Berlin, was also reported.

Mr. Lesley read a letter from G. S. Blake, an officer on the U. S. Frigate, Java, in 1830, dated Nov. 12. 1877 (?), to Dr. Hedge of Harvard College, containing two extracts from his Journal, July 15, 1830, Port Mahon, and July 30, 1830, Algiers, respecting Dr. Timison, Surgeon U. S. N., on board the Java, the grandson of Red Jacket, and a pure Seneca Indian, who was graduated at Schenectady, N. Y., and died when the Java touched at Algiers. At Port Mahon Dr. Jimison encountered a Kabyle chief, a prisoner, addressed him in the Seneca language, and reported to Mr. Blake that the Kabyle evidently comprehended him. The death of Jimison prevented further experiments with Kabyles on their arrival at Algiers.

"Longwood, Saturday, 12th November.

"My Dear Sir:—A few days since, you expressed a wish that I would give you, in writing, the particulars of the incident which I related at the dinner at Mr. G. B. B's, and which we both regard as one of considerable interest. I cannot do better, perhaps, than to give you an extract from my journal:

"'Frigate "Java." Port Mahon, Island of Minorca, 15th July, 1830.

"'The French frigate which arrived recently from Algiers, completed her quarantine, and took pratique this morning, and sails soon for Toulon. She has on board a number of Kabyles, captured in the engagement of the 24th June, near Torrechica.

"'Dr. Jimison, who happened to be at the Lazaretto when she was admitted to pratique, took me aside on his return, and told me that he caught the eye of one of the prisoners (a chief he thought), and that, as he returned his glance, seemingly with interest, he ventured to speak to him, and addressed him in the language of the Seneca tribe of Indians, and that to his inexpressible surprise, *they certainly, to some extent, could understand each other*. I tried to draw from him some particulars in regard to the nature of their communication, but could not, except that it related to the late military events. I am deeply interested in the matter, and it is understood between us, that when we arrive at Algiers, he will endeavor to following it up in my presence.

"'Friday, July 30th. At 6 P. M., anchored off Algiers, and 10 o'clock, Assistant Surgeon Jacob Jimison died. He was to me, a most interesting person. He was of the Seneca tribe of Indians, of pure blood, so said, the son a chief, and a grand-son of the celebrated "Red Jacket." He was educated carefully, and a graduate of Schenectady College. He entered the Navy in January, 1828; this was his first cruise.'

"I cultivated his acquaintance, which was rather difficult to do, for he was grave, thoughtful, and very taciturn, but, perhaps he was as intimate with me as with any other ward room officer.

"He died of a land fever, after an illness of about ten days.

"All this is very vague, but you will take it for what it is worth. I will only add, that Jimison was not, in my opinion, a person likely by any means, to play upon the credulity of any one. He most certainly, fully believed what he related to me.

"Believe me with great respect and regard, yours,

"G. S. BLAKE.

"REV. DR. HEDGE."

Prof. Cope made, through the Secretaries, a written communication on the occurrence of the remains of man in association with those of extinct vertebrata in Oregon, entitled:

"PLIOCENE MAN.—Prof. Cope stated that he had received from Oregon a collection of fossils from an ancient lake bed of Pliocene age, which includes the following species of *Mammalia*: *Elephas primigenius*, *Equus occidentalis*; *E. major*; *Auchenia hesterna*; *Auchenia magna*; *Auchenia vitakeriana* sp. nov.; *Mylodon sodalis*; *Lutra? piscinaria* and *Canis latrans*.

"Of Birds: bones not distinguishable from those *Podiceps occidentalis* and *Podilymbus podiceps*; others of *Graculus* larger than those of *Graculus dilophus*. Fishes: *Catostomidæ* and *Cyprinidæ*, of extinct species of *Alburnops* and *Anchybopsis*. Mingled in the same deposit in undistinguishable relation, were found numerous flakes with arrow and spear heads of obsidian, many of them much tarnished by long erosion. All were lying mingled together on the surface of a bed of clay, which was covered by a deposit of 'volcanic sand and ashes' of from fifteen to twenty feet in depth. This had been drifted away by the wind in some localities, thus exposing the remains. Great numbers of specimens of the fresh water-shell *Carinifex newberryi*, of a white color, were found with the vertebrate fossils. The locality is the basin of a lake, a small remnant of which still remains and is visited by numbers of *Mammalia* and water-birds at the present time."

Mr. Chase presented some equations of relation between planetary masses, times and distances, in all of which the velocity of light entered as an important factor.

Mr. Lesley was elected Librarian.

The Standing Committees were re-elected without change.

The Roll of Surviving Members was read.

Pending nominations, Nos. 840 to 851, and new nomination 852 were read, spoken to and balloted for, and on scrutiny of the ballot boxes by the presiding officer the following persons were declared duly elected members of the Society:

840. Mr. I. F. Mansfield, of Cannelton, Beaver Co., Pa.

841. Prof. I. C. White, of West Virginia University, Morgantown, W. Va.

842. Mr. F. A. Randall, of Warren, Pennsylvania.

843. Mr. Burnett Landreth, of Bristol, Pa.

844. Mr. John Price Wetherill, of Philadelphia.

845. Mr. Elisha Gray, Sc. D., of Chicago, Ill.

846. Mr. Simon Newcomb, of the Superintendent Nautical Almanac Office at Washington, D. C.

847. Mr. Asaph Hall, U.S. Observatory, Washington, D.C.

848. Dr. Theo. G. Wormley, Prof. Chem. in the Med. Dep. of the University of Pennsylvania.

849. Dr. C. H. F. Peters, Prof. Astr., Hamilton Coll., N.Y.

850. Mr. Jas. C. Watson, Prof. Astr., Ann Arbor, Michigan.

851. Mr. Francis Andrew March, Prof. of Languages in Lafayette College, at Easton, Pennsylvania.

And the meeting was adjourned.

Results of Wave Interferences.

By Pliny Earle Chase, LL.D.,

Professor of Philosophy in Haverford College.

(Read before the American Philosophical Society September 21 *and October* 19, 1877, *and January* 18, 1878.)

The combined influences of action and reaction, elasticity, density, and fundamental velocity, in the arrangement of the solar system, are shown by the symmetrical formula,

$$\left(\frac{\mu + \mu_1}{\mu_1}\right)^{\frac{\lambda_1 + \lambda}{\lambda}} = \frac{\rho_1 + \rho}{\rho} \qquad (1.)$$

in which μ = mass of Sun ; μ_1 = mass of Jupiter ; λ = average velocity of complete solar dissociation = 214.86 $\rho \div 497.825$ = velocity of light ; $\lambda_1 = 2\sqrt{g\rho} = 2 \times$ velocity of incipient solar dissociation = mean radial velocity of complete solar dissociation $= \dfrac{4 \times (214.86)^{\frac{3}{2}} \pi\rho}{\text{No. seconds in 1 year}}$; ρ_1 = Jupiter's projectile radius or mean perihelion distance from Sun ; ρ = Sun's equatorial radius. Substituting the values $\lambda = \rho \div 2.317$; $\lambda_1 = \rho \div 344.15$; $\rho_1 = 1069.62$; $\rho = 1$; the equation reduces to

$$\left(\frac{\mu + \mu_1}{\mu_1}\right)^{1.0029} = 1070.62 \quad \therefore \quad \frac{\mu + \mu_1}{\mu_1} = 1049.24.$$

Bessel's estimate is 1048.88 ; the difference between the theoretical and the observed value being only $\frac{1}{29}$ of 1 per cent.

The velocity of light also appears as an important factor in the following equations, thus furnishing further evidence, both of the significance of Earth's position, at the centre of the belt of greatest condensation, and of Jupiter's influence :

$$\frac{(n\pi)^3 \sqrt{fr}}{\triangle} = \lambda \qquad (2)$$

$$\frac{\mu}{\mu_2} = \left(\frac{\lambda}{\lambda_1}\right)^2 \times 2^{\frac{3}{2}} \qquad (3)$$

$$\frac{\delta}{\rho} = \frac{\lambda}{\lambda_1} \times 2^{\frac{2}{3}} \qquad (4)$$

$$t_2 = \frac{\lambda}{\lambda_1} \times 1.061 \text{ days.} \qquad (5)$$

$$t : t_1 : : \lambda_1 : \lambda \qquad (6)$$

In these equations $n\pi\sqrt{fr}$ = terrestrial dissociative velocity : u_2 =

mass of Earth ; $\triangle$ = density of Earth in units of Sun's density ; $2^{\frac{3}{2}}$ = time of revolution at $2\,r$; $2^{\frac{2}{3}}$ = radius of revolution for $2\,t$; δ = Earth's mean distance from Sun ; t = time of oscillation through major-axis equivaent to Sun's possible atmosphere, or to $\frac{1}{8}$ of Earth's radius vector ; t_1 = time of Jupiter's revolution ; t_2 = time of Earth's revolution ; 1.061 = Jupiter's $\frac{\text{secular aphelion}}{\text{mean}}$ radius vector.

It is evident, from equation (6), that $\frac{t + t_1}{t_1}$ might be substituted for $\frac{\lambda_1 + \lambda}{\lambda}$, in the exponent of equation (1).

In the undulations which are generated by the two controlling masses, μ and μ_1, we may naturally look for harmonic interferences, not only in the light spectrum, but also in cosmical aggregations and in elementary molecular groupings. If we compare μ and μ_1 at Jupiter's present perihelion, we find that the product of Jupiter's radius vector by its mass is 1.0153 times the product of Sun's radius by its mass. Representing 1.0153 by n, and taking $a = 6 \times .0153 = .0918$, the harmonic progression, $\frac{1}{n + a}$, $\frac{1}{n + 2\,a}$, $\frac{1}{n + 3\,a}$, etc., gives us the following nodal divisors and approximations, in millionths of a millimetre, to wave-lengths of Fraunhofer lines :

Denominators.	Nodal Divisors.	Quotients.	Observed.	
1	1.0000	761.20	A	761.20
$n + a$ (f)	1.1071	687.56	B	687.49
	[1.1530	660.19]	C	656.67
$n + 2\,a$	1.1989	634.92		
$n + 3\,a$ (f)	1.2907	589.76	D	589 74
$n + 4\,a$	1.3825	550.60		
	[1.4437	527.26]	E	527.38
$n + 5\,a$	1.4743	516.31	b	517.70
$n + 6\,a$ (f)	1.5661	486.05	F	486.52
$n + 7\,a$	1.6579	459.13		
$n + 8\,a$	1.7497	435.05	G	431.03
	[1.7650	431.27]		
$n + 9\,a$	1.8415	413.37		
	[1.9180	396.87]	H	397.16
$n + 10\,a$ (f)	1.9333	393.73	H^1	393.59

The harmonic interferences indicated by the series marked (f) are the most interesting, both on account of the closeness between the theoretical quotients and the corresponding observed values, and because the successive denominator increments, are figurate.

Of the remaining six lines, three (A, b, G,) approximate so closely to the corresponding harmonic quotients, the greatest deviation being less than one per cent., that they may be properly regarded as illustrations of secondary interferences; introducing two harmonic triplets, with a uniform denominator difference of 2 a, ($n + 2\,a$, $4\,a$, $6\,a$; $n + 6\,a$, $8\,a$, $10\,a$).

The bracketed divisors indicate tertiary harmonics, based on denominator differences of $a' = .0153$: $1.1530 = 1 + 10\,a'$; $1.4437 = 1 + 29\,a'$; $1.7650 = 1 + 50\,a'$; $1.9180 = 1 + 60\,a'$. The greatest difference between the theoretical and observed values is less than $\frac{5}{8}$ of one per cent.; the other differences range between $\frac{1}{44}$ and $\frac{1}{13}$ of one per cent.

Among the subordinate spectral lines there are some as I have shown elsewhere,* which are closely represented by the denominators $n + 2\,a$, $n + 4\,a$, $n + 5\,a$, $n + 7\,a$, $n + 8\,a$, $n + 9\,a$. But, on account of the great number of faint lines, such accordances are less satisfactory than those which can be found in the lines which are more widely separated and more prominent.

In planetary aggregation the interference waves have manifested their influence most strikingly at luminous internodes. The denominators are exponential, indicating roots which are to be extracted, instead of divisions which are to be made. It will be noticed that the first six exponential denominators in the following table, are arithmetical means between the adjacent numbers in the primitive series of nodal divisors in the foregoing table, and that the others are formed by successive denominator increments of $\frac{5}{4}\,a$.

Exponential Denominators.	Roots.	Observed.	
1.0000	6453	6453	Neptune.
1.0536	4130	4122	Uranus.
1.1530	2015	2050	Saturn.
1.2448	1150	1118	Jupiter.
1.3366	708	728	Freia.
1.4284	465	473	Flora.
1.5202	321	327	Mars,
1.6350	214	215	Earth.
1.7497	150	155	Venus.
1,8644	111	110	Ven.-Mer.
1.9792	84	83	Mercury.
2.0939	66	64	Mercury, s. p.
2.2089	53	53	Mercury, c. o.

The "observed" values are the mean planetary vector-radii, in units of Sun's radius. "Ven.-Mer." is the arithmetical mean between Venus's mean distance (155) and Mercury's secular perihelion (64). "Mercury, c. o." is the centre of spherical oscillation ($\sqrt{.4}$) of a nebula extending to Mercury's mean distance.

The harmonic interferences in the spectra of chemical elements may probably be best studied, by beginning with those which contain few prominent lines. The wave-measurements, in all of the following comparisons, are taken from the paper of Professor Wolcott Gibbs, in the American Journal of Science, second series, vol. xlvii, pp. 198, seq. Kirchhoff's lines are indicated by K; Huggins's by H; Gibbs's groupings of corresponding lines, in the observations of both Kirchhoff and Huggins, by K H; the left-hand columns containing Kirchhoff's estimates, and the right-hand columns those of Huggins:

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* *Ante*, p. 110.

MERCURY, K H.

Wave-lengths.		Quotients.		Theoretical.	
568.47	568.55	1.0000	1.0000	1.0000	1
546.33	546.13	1.0407	1.0411	1.0406	1 + 6 *a*
542.80	542.80	1.0473	1.0484	1.0474	1 + 7 *a*

LEAD, K H.

Wave-lengths.		Quotients.		Theoretical.	
561.29	561.46	1.0000	1.0000	1.0000	1
537.71	537.85	1.0439	1.0439	1.0440	1 + 3 *a*
439.07	438.93	1.2784	1.2792	1.2784	1 + 19 *a*

LITHIUM, H.

Wave-lengths.	Quotients.	Theoretical.	
610.73	1.0000	1.0000	1
479.48	1.2277	1.2214	1 + 2 *a*
459.93	1.3279	1.3321	1 + 3 *a*

RUTHENIUM AND IRIDIUM, K.

Wave-lengths.	Quotients.	Theoretical	
635.45	1.0000	1.0000	1
545.44	1.1650	1.1646	1 + 5 *a*
530.52	1.1973	1.1975	1 + 6 *a*

CHROMIUM, K.

Wave-lengths.	Quotients.	Theoretical.	
541.35	1.0000	1.0000	1
521.20	1.0387	1.0387	1 + 111 *a*
520.96	1.0391	1.0391	1 + 112 *a*
520.83	1.0394	1.0394	1 + 113 *a*

COPPER, K.

Wave-lengths.	Quotients.	Theoretical.	
578.67	1.0000	1.0000	1
529.30	1.0933	1.0914	1 + 6 *a*
522.24	1.1070	1.1066	1 + 7 *a*
465.64	1.2428	1.2437	1 + 16 *a*

Arsenic, K H.

Wave-lengths.		Quotients.		Theoretical.	
617.54	617.67	1.0000	1.0000	1.0000	1
611.69	611.67	1.0096	1.0098	1.0093	$1 + a$
578.95	578.73	1.0667	1.0673	1.0650	$1 + 7a$
533.55	533.41	1.1566	1.1580	1.1579	$1 + 17a$

Magnesium, K.

Wave-lengths.	Quotients.	Theoretical.	
518.73	1.0000	1.0000	1
517.64	1.0021	1.0020	$1 + 2a$
517.17	1.0030	1.0030	$1 + 3a$
459.62	1.1286	1.1285	$1 + 9b$
448.57	1.1564		
448.39	1.1569	1.1570	$1 + 11b$

Tin, K H.

Wave-lengths.		Quotients.		Theoretical.	
645.83	645.27	1.0000	1.0000	1.0000	1
615.59		1.0491		1.0530	$1 + a$
556.83		1.1598		1.1590	$1 + 3a$
556.59		1.1604		1.1620	$1 + 2b$
510.55	510.40	1.2650	1.2642	1.2650	$1 + 5a$
459.47		1.4056		1.4050	$1 + 5b$
453.41		1.4244		1.4240	$1 + 8a$

Potassium, H.

Wave-lengths.	Quotients.	Theoretical.	
630.85	1.0000	1.0000	1
624.81	1.0097	1.0097	$1 + \frac{1}{3}a$
613.25	1.0287	1.0291	$1 + a$
583.78	1.0806	1.0802	$1 + c$
581.79	1.0843	1.0843	$1 + b$
580.80	1.0862	1.0872	$1 + 3a$
551.96	1.1430	1.1454	$1 + 5a$
483.18	1.3360	1.3371	$1 + 4b$
438.96	1.4372	1.4362	$1 + 15a$
431.16	1.4632	1.4653	$1 + 16a$
426.00	1.4809	1.4810	$1 + 6c$
418.77	1.5064	1.5057	$1 + 6b$

Silver, K H.

Wave-lengths.		Quotients.		Theoretical.	
547.55	547.44	1.0000	1.0000	1.0000	1
546.96	546.63	1.0011	1.0015	1.0013	$1 + a$
521.32	521.34	1.0503	1.0501	1.0502	$1 + 38a$

This cannot be regarded as a satisfactory accordance.

ZINC, K H.

Wave-lengths.		Quotients.		Theoretical.	
636.99	637.37	1.0000	1.0000	1.0000	1
610.64	610.89	1.0432	1.0442	1.0390	$1 + a$
589.90	589.90	1.0798	1.0805	1.0781	$1 + 2a$
472.25	471.98	1.3488	1.3504	1.3513	$1 + 9a$

CADMIUM, K H.

Wave-lengths.		Quotients.		Theoretical.	
647.22	647.08	1.0000	1.0000	1.0000	1
644.59		1.0041		1.0041	$1 + a \div 28$
531.27	531.01	1.2182	1.2186	1.2300	$1 + 2a$
509.00	508.83	1.2715	1.2717	1.2727	$1 + 5b$
480.56	480.27	1.3468	1.3478	1.3450	$1 + 3a$
468.10		1.3826		1.3818	$1 + 7b$
441.94	441.81	1.4645	1.4646	1.4600	$1 + 4a$

The quotient of Kirchhoff's sixth wave-length by the seventh (468.10 ÷ 441.94), is equal to the quotient of the fourth by the fifth (509 ÷ 480.56 = 1.0592). The harmonic denominators, $1 + 7c$, $1 + 11c$, $1 + 15c$—if $c = 311.6$—give 1.2181, 1.3428, 1.4674; but this is not so satisfactory a representation, on the whole, as the one I have adopted. $(2 + 3 + 4)a = (5 + 2 \times 7)b$.

LANTHANUM, K.

Wave-lengths.	Quotients.	Theoretical.	
538.56	1.0000	1.0000	1
538.43	1.0003	1.0003	$1 + \frac{1}{4}a$
538.00	1.0011	1.0011	$1 + a$
534.48	1.0077	1.0077	$1 + 7a$
520.80	1.0341	1.0340	$1 + 31a$
519.20	1.0373	1.0373	$1 + 34a$
518.69	1.0383	1.0384	$1 + 35a$
481.59	1.1183	1.1183	$1 + 108a$

SODIUM, H.

Wave-lengths.	Quotients.	Theoretical.	
616.74	1.0000	1.0000	1
616.56	1.0002		
590.04	1.0452	1.0455	$1 + 6a$ $(6 = 1 + 5)$
589.43	1.0462		
569.46	1.0830	1.0835	$1 + 11a$ $(11 = 1 + 2 \times 5)$
568.90	1.0840		
515.90	1.1954		
515.37	1.1966	1.1973	$1 + 26a$ $(26 = 1 + 5 \times 5)$
498.87	1.2362	1.2362	$1 + 31a$ $(31 = 1 + 6 \times 5)$

ANTIMONY, K H.

Wave-lengths.		Quotients.		Theoretical.	
630.84	630.49	1.0000	1.0000	1.0000	1
613.50	613.73	1.0283	1.0273	1.0270	$1 + 2a$
598.41	598.72	1.0542	1.0531	1.0540	$1 + 4a$
591.61	591.45	1.0663	1.0660		
589.76	589.76	1.0697	1.0691	1.0675	$1 + 5a$
564.54	564.41	1.1174	1.1171	1.1165	$1 + 3b$
557.19	557.18	1.1322	1.1316	1.1350	$1 + 10a$
546.61	546.33	1.1554	1.1540	1.1553	$1 + 4b$
471.10	471.03	1.3391	1.3385	1.3375	$1 + 25a$

ARSENIC, K.

Wave-lengths.	Quotients.	Theoretical.	
617.54	1.0000	1.0000	1
611.69	1.0096	1.0093	$1 + a$
603.38	1.0235	1.0244	$1 + 2b$
578.95	1.0666	1.0653	$1 + 7a$
558.29	1.1063	1.1096	$1 + 9b$
550.42	1.1219	1.1217	$1 + 10b$
538.75	1.1462	1.1461	$1 + 12b$
533.55	1.1574	1.1585	$1 + 17a$
521.32	1.1846	1.1826	$1 + 15b$

The sixth quotient is also very nearly $1.1212 = 1 + 13a$; or $13a = 10b$.

BARIUM, K H.

Wave-lengths.		Quotients.		Theoretical.	
650.24	650.44	1.0000	1.0000	1.0000	1
611.75	612.15	1.0629	1.0625	1.0634	$1 + 4a$
603.08	602.70	1.0782	1.0792	1.0792	$1 + 5a$
597.05	597.58	1.0891	1.0885	1.0890	$1 + 15c$
585.51	585.67	1.1106	1.1106	1.1109	$1 + 7a$
582.88	582.77	1.1156	1.1161	1.1159	$1 + 2b$
578.51	578.00	1.1240	1.1253	1.1246	$1 + 21c$
553.95	554.06	1.1738	1.1740	1.1739	$1 + 3b$
552.40	552.06	1.1771	1.1782	1.1780	$1 + 30c$
493.78	493.57	1.3168	1.3178	1.3168	$1 + 20a$
490.20	490.23	1.3265	1.3268	1.3264	$1 + 55c$

The eighth quotient is also very nearly $1 + 11a = 1.1742$; or $113 = 3b$.

STRONTIUM, K H.

Wave-lengths.		Quotients.		Theoretical.	
641.38	641.39	1.0000	1.0000	1.0000	
553.90	553.74	1.1579	1.1583	1.1592	$1 + d$
552.57	552.38	1.1607	1.1614	1.1610	$1 + e$
550.83	550.61	1.1645	1.1649	1.1647	$1 + aa$

STRONTIUM, K. H.—*Continued.*

Wave-lengths.		Quotients.		Theoretical.	
549.11	549.78	1.1680	1.1666	1.1675	$1 + 3\,b$
548.68	548.75	1.1689	1.1686	1.1691	$1 + 3\,c$
525.98	525.95	1.2194	1.2195	1.2195	$1 + 4\,a$
524.18	524.26	1.2236	1.2234	1.2234	$1 + 4\,b$
523.24	523.23	1.2258	1.2258	1.2255	$1 + 4\,c$
522.97	522.83	1.2264	1.2268	1.2266	$1 + \rho\,d$
522.71	522.60	1.2270	1.2273	1.2272	$1 + \sqrt{2}\,e$

The ratio between the first and the ninth harmonic increment, $\rho = 1.4232$, is my theoretical value for the ratio between heat of constant pressure and heat of constant volume;* the ratio between the second and the tenth harmonic increment, $\sqrt{2}$, is the ratio between dissociative- or wave-velocity, and stable- or circular-velocity. The geometric mean of 1.1645, 1.1680, 1.1689, is $1.1671 = 1 + 3\,b'$; $(1.2194 \times 1.2236 \times 1.2258)^{\frac{1}{3}} = 1.2229 = 1 + 4\,b'$. Huggins's means are not so theoretically exact, but their deviation is far within the limits of probable error, for $(1.1649 \times 1.1666 \times 1.1686)^{\frac{1}{3}} = 1.1668$; $(1.2195 \times 1.2234 \times 1.2258)^{\frac{1}{3}} = 1.2229$; $1 + 3\,b'' = 1.1670$; $1 + 4\,b'' = 1.2227$. Kirchhoff gives the following additional lines:

(2) STRONTIUM, K.

Wave-lengths.	Quotients.	Theoretical.	
650.68	.9857		
554.52	1.1566		
461.69	1.3892	1.3893	$1 + 4\,a'$
461.62	1.3894	1.3898	$1 + 4\,b'$
431.38	1.4868	1.4867	$1 + 5\,a'$
431.18	1.4875	1.4872	$1 + 5\,b'$

PLATINUM, K H.

Wave-lengths.		Quotients.		Theoretical.	
598.22	598.14	1.0000	1.0000	1.0000	
596.86	596.59	1.0023	1.0026	1.0026	$1 + 3\,a$
595.62	595.47	1.0044	1.0045	1.0044	$1 + 5\,a$
548.07	547.95	1.0915	1.0916	1.0910	$1 + 5\,b$
530.70	530.76	1.1272	1.1270	1.1275	$1 + 7\,b$
523.10	523.08	1.1436	1.1435	1.1419	$1 + 7\,c$
506.43	506.32	1.1812	1.1813	1.1825	$1 + 9\,e$
456.19	454.92	1.3113	1.3148	1.3129	$1 + 20\,d$
450.77	449.72	1.3271	1.3300	1.3285	$1 + 21\,d$
445.65	444.45	1.3424	1.3455	1.3442	$1 + 22\,d$

This is not given among the comparisons in Gibbs's Table XI, but it embraces all the lines in which Huggins's measurements (Table IV) and

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* Proc. Soc. Phil. Amer., xiv, 651.

Kirchhoff's (Table IX) differ by less than a unit. The groups may be connected by the equations, $21\,a = b$; $10\,b = 9\,c$; $6\,b = 7\,d$.

The foregoing investigations were undertaken in consequence of a suggestion by Professor Henry Draper, that I should test my theory of harmonic undulatory influence by an examination of spectral lines. Professor Asaph Hall led me to the discovery of further corroborative tests, by the query, "Will the inner moon of Mars fall into harmony, or will it make a discord?" *

If we start from a point near the theoretical beginning of nebular condensation for the outer satellite,† and take $2 \times 3 - 1$ harmonic divisors, of the form $\text{div.}_{n+1} = 3\,\text{div.}_n - \text{div.}_1 = \text{div.}_n + 3^{n-1}$, we find the following accordances:

Numerator.	Divisors.	Quotients.	Observed.
13.7	$d_1 = 1$	13.700	13.692 = Nebular radius.
	$d_2 = 3\,d_1 - d_1 = 2$	6.850	6.846 = Deimus.‡
	$d_3 = 3\,d_2 - d_1 = 5$	2.740	2.730 = Phobus.‡
	$d_4 = 3\,d_3 - d_1 = 14$	.979	1.000 = ♂ semi-diam.
	$d_5 = 3\,d_4 - d_1 = 41$	.334	.333 = ♂ c. of rad. osc.

In a letter to the editors of the *American Journal of Science and Arts* (Oct., 1877, p. 327), Professor Kirkwood calls attention to the rapid motion of the inner satellite, and asks: "How is this remarkable fact to be reconciled with the cosmogony of Laplace?" He suggests a partial explanation, based upon the motions of Saturn's ring, and concludes with the remark: "Unless some such explanation as this can be given, the short period of the inner satellite will doubtless be regarded as a conclusive argument against the nebular hypothesis."

This is undoubtedly true, if we accept the nebular hypothesis in the form in which it is popularly taught, and in which Laplace is commonly supposed to have held it. But there are probably very few among the students who have given the subject much careful attention, who have supposed that all the planet-building has taken place at the "limit of possible atmosphere," or the point of equal centripetal and centrifugal force. It may well be doubted whether the illustrious French Astromomer ever held such an opinion, and it is certain that Sir William Herschel never did, for he speculated on the "gradual subsidence and condensation" of nebulous matter "by the effect of its own gravity, into more or less regular spherical or spheroidal forms, denser (as they must in that case be) towards the centre." §

As necessary consequences of such subsidence, there would be an acceleration of velocity in all the nebular particles, the acceleration being more rapid in the nucleus, than near the outer surface of the nebula. Many indications point to the simultaneous, or nearly simultaneous, initiation of numerous planetary centres, and it is very doubtful if either of the two-planet belts, except, perhaps, that of Neptune and Uranus, will be long regarded as having been "thrown off" by the mere increase of centrifugal velocity.

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* See Journal of the Franklin Institute, Nov., 1877.

† *Phil. Mag.* Oct., 1877, p. 292.

‡ These are the names proposed for the satellites by their discoverer, Prof. Asaph Hall.

§ Herschel's "Outlines of Astronomy," § 871.

At the very outset of my own investigations,* I was careful to limit my acceptance of the nebuar hypothesis to the qualified exposition of its originator, as stated by Sir John Herschel: "Neither is there any variety of aspect which nebulæ offer, which stands at all in contradiction to this view. Even though we should feel ourselves compelled to reject the idea of a gaseous or vaporous 'nebulous matter,' it loses little or none of its force. Subsidence, and the central aggregation consequent on subsidence, may go on quite as well among a multitude of discrete bodies, under the influence of mutual attraction, and feeble or partially opposing projectile motions, as among the particles of a gaseous fluid." †

It matters not whether there is such a thing as a luminiferous æther, or whether the hypothesis of such an entity is merely a convenient assumption for the co-ordination of results which are due to the action of forces *such as would exist* in such a medium. The proper study of the forces, and of their mathematical consequences, is the great thing to be sought, and the numerous accordances which I have already found, show how prolific such studies may become. Those accordances, as it seems to me, are already sufficient to establish the Herschelian hypothesis as a true theory, beyond the reach of all possible controversy. That the elastic, or quasi-elastic, forces, which are continually operating throughout the solar system, should extend the harmonic laws to the satellites, as well as to the planets and to the spectral lines, is a necessary consequence of the simplicity and unity of design which underlie the manifold phenomena of the universe.

In the case of our own moon, as we have only two terms, Earth's semi-diameter and Moon's orbital major-axis, the harmonic equation is indeterminate; its direct solution is, therefore, impossible. I have elsewhere, however, called attention to the fact that Earth is central, in the belt which is bounded by the secular perihelion of Mercury and the secular aphelion of Mars, and this fact, together with the nearly synchronous rotation of all the planets in the belt, may be regarded as indications of common forces, such as would be likely to lead to common harmonies. The sixth and seventh divisors of the Mars series represent, respectively, the ratio of Earth's semi-diameter to Moon's major-axis, and the ratio of Earth's axial rotation to its orbital revolution, viz.:

$$d_6 = 3\,d_5 - d_1 = 122. \qquad 120.5331 = \text{Moon's major-axis.}$$
$$d_7 = 3\,d_6 - d_1 = 365. \qquad 365.2564 = \text{Earth's year.}$$

The harmonic series, of which Mars and its satellites form a part, seems to have been established before the ring of greatest nebular condensation—the ring of which Earth was the centre—was broken up. In the solar system, as well as in the group of densest planets, the number 3, which represents the uneven harmonics of an organ-pipe, as well as the oscillatory divisions of a linear pendulum, holds a prominent place. For we find, at the outset, the following approximations to important nebular centres:

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* *Phil. Mag.*, April, 1876.

† *Loc. cit.*

$3^8 =$	$9^4 =$	6561	6518 =	Neptune's secular aphelion.
3^7		2187	2222	Saturn's secular aphelion.
3^6	9^3	729	735	Cybele.
3^5		243	229	Earth's secular aphelion.
3^4	9^2	81	83	Mercury.
3^3		27	..	
3^2	9^1	9	..	
3^1		3	..	
3^0	9^0	1	1	Sun's semi-diameter.

This accordance is the more significant, because Saturn's secular aphelion is at the centre of the ring of secondary condensation, which extends from Sun's surface to Uranus's secular aphelion.

"Bode's Law," was based on successive differences of $2^0 \times 3$, $2^1 \times 3$, $2^2 \times 3$, etc. If we substract 1 from each of the theoretical Bode numbers, and divide the remainders by 3, the quotients are 1, 2, 3, 5, 9, 17, etc., each of the quotients, except those for Venus and Neptune, being of the form $d_{n+1} = 2\, d_n - 1$; the dense-belt series being of the form $d_{n+1} = 3\, d_n - 1$.

In the infinite series, $\frac{1}{2} + 3^{-\infty} + 3^{-\infty+1} + \ldots 3^{-1} + 3^0 + 3^1 + 3^2 + \ldots$, successive sums, in the neighborhood of unity, give the following accordances:

Sums.	Harmonic Divisors.	Quotients.	Observed.
$\frac{1}{2}$ =	$\frac{1}{2}$	27.38	27.00 = 3^3.
$+ 3^{-\infty}$	.	.	.
+ .	.	.	.
+ .	.	.	.
$+ 3^{-4}$	$\frac{14}{27}$	26.40	26.20 Extreme major-axis.
$+ 3^{-3}$	$\frac{5}{9}$	24.64	24.39 Mean major-axis.
$+ 3^{-2}$	$\frac{2}{3}$	20.53	20.68 Extreme secondary radius.
$+ 3^{-1}$	1	13.69	13.69 Nebular radius.
$+ 3^0$	2	6.85	6.85 Deimus.
$+ 3^1$	5	2.74	2.73 Phobus.
$+ 3^2$	14	.98	1.00 Semi-diameter of Mars.
$+ 3^3$	41	.33	.33 Oscillatory centre.
$+ 3^4$	122		120.56 Moon's major-axis.
$+ 3^5$	365		365.26 Terrestrial acceleration.
$+ 3^6$	1094		1096.20 Jupiter's semi-major-axis.

The "Extreme major-axis" is the major-axis of an ellipse, connecting the inner planets of the two outer two-planet belts at the secular aphelia of Uranus and Jupiter; the "Mean major-axis" is the sum of the mean distances of Uranus and Jupiter; the "Extreme secondary radius" is Uranus's aphelion radius, or the semi-diameter of the ring of secondary condensation; the "Nebular radius" not only represents the theoretical incipience of Mars's nebular condensation, but it also corresponds, almost precisely, with the sum of the secular perihelia of Jupiter (4.886) and Saturn (8.734), in units of Earth's semi-major-axis—the secular perihelion being the time of greatest orbital *vis viva;* "Moon's major-axis" is also Earth's "Nebular radius;" the "Terrestrial acceleration" represents the theoretical increase in the angular velocity of Earth's rotation, since its rupture from the central nucleus, or the ratio of its day to its year; "Jupiter's semi-major-axis" is measured in units of Sun's mean perihelion distance from the centre of gravity of Sun and Jupiter.

The sum of the infinite series, to and including 3^{-3}, is $\frac{5}{9}$, which represents the ratio of *vis viva* between undulatory velocity and the velocity of the particles of a medium constituted according to the Kinetic theory.* Alexander has shown the importance of that ratio in planeto-taxis,† and I have shown that it represents "centres of explosive oscillation," or the centre of secondary oscillation between the primary centre of oscillation and the centre of gravity, in a homogeneous line of particles ($\frac{2}{3} - \frac{2}{3}$ of $\frac{1}{6} = \frac{5}{9}$). Adding the next term of the series, we get $\frac{2}{3}$, which represents the centre of linear oscillation. Neptune's major-axis (60.06) is, within $\frac{1}{10}$ of 1 per cent., ($3^4 - 3^3 + 3^2 - 3^1 = 60$) times Earth's mean radius vector.

These harmonies embrace orbital radii of the largest five planets of the solar system, of the inner planets, and of the asteroidal belt, together with nebular-, satellite-, and planetary-radii, for the outer and the middle planets in the theoretically primitive central belt, or the belt of greatest condensation. Can any interpretation be rightly put upon such a chain of harmonies, which does not recognize the fundamental laws of harmonic oscillation and harmonic design?

Neither of Mars's moons is of sufficient magnitude to cause any great perturbations. To this fact, perhaps, as much as to the proximity of the density-centre, we may attribute the regularity of the Mavortian system. In the solar system, as we have seen,‡ the preponderating mass of Jupiter sets up a new order of differences in the harmonic denominators; and we may find probable indications of similar influence in some of the satellite systems, and in the elementary spectra.

In the satellite system of Uranus, if we take the semi-major-axis of the outer satellite as the common numerator (22.75), we find the following harmony:

Satellites.	Distances.	Denominators.	Theoretical.
Oberon,	22.75	1.000	1.000
Titania,	17.01	1.337	$1.343 = 1 + 2a$
Umbriel,	10.37	2.194	$2.199 = 1 + 7a$
Ariel,	7.44	3.058	$3.055 = 1 + 12a$
Semi-diameter,	1.00	22.750	$22.750 = 1 + 127a$

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* Maxwell and Preston, *Phil. Mag.*, June, 1877.

† Smithsonian Contributions, 280.

‡ *Ante*, xii, 403*sqq.*; xiii, 237-9; etc.

In the Saturnian system there is a slight uncertainty in the satellite elements, except in the case of Titan, whose orbit was well determined by Bessel. It will be seen that Titan's great mass introduces a secondary harmony. The following harmonic denominators are based upon relative mean distances which would represent the orbital times, as furnished by Professor Hall:

Satellites.	Times.	Denominators.	Theoretical.	
Japetus,	79.3292^d	1.000	1.000	
Hyperion,	21.3118	2,402	2.397 =	$1 + a$
Titan,	15.9454	2.914	2.920	$1 + b$
Rhea,	4.5175	6.756	6.760	$1 + 3b$
Dione,	2.7369	9.436	9.384	$1 + 6a$
Tethys,	1.8878	12.087	12.179	$1 + 8a$
Enceladus,	1.3702	14.966	14.974	$1 + 10a$
Mimas.	.9425	19.206	19.166	$1 + 13a$
Semi-diameter,		64.359	64.360	$1 + 33b$

It is well to notice that b (1.920) is very nearly the square of a (1.397).

In the column of times, Japetus, divided by Titan, is nearly 5; Hyperion, by Rhea, 5; Dione, by Enceladus, 2; Tethys, by Mimas, 2; Titan, by Rhea, $\frac{7}{2}$; Rhea, by Dione, $\frac{5}{3}$; Hyperion, by Titan, $\frac{4}{3}$; Hyperion, by Dione, 8; Hyperion, by Mimas, $\frac{45}{2}$; Titan, by Mimas, 17.

The satellite system of Jupiter, our Sun's "companion star," exhibits harmonies of distance, time and mass. The mean distance of the outer satellite, Callisto, is 3^3 semi-diameters of its primary (26.9984). Using this as a common numerator, we find that the other satellites are phyllotactically, as well as harmonically, arranged:

Satellites.	Distances.	Denominators.	Theoretical.	
Callisto,	26.9984	1.000		
Ganymede,	15.3502	1.759	1.731 =	$5a$.
Europa,	9.6235	2.807	2.769	$8a$.
Io,	6.0485	4.464	4.500	$13a$.
Semi-diameter,	1.0000	26.998	26.998	$78a$.

The harmonies of time and mass are as follows:

Satellites.	Times.	Theoretical.		Mass.	Theoretical.	
Callisto,	16.689^d	16.684 =	$28t$	4266	4403 =	$\frac{1}{2}m$.
Ganymede,	7.155	7.150	$12t$	8850	8806	$1m$.
Europa,	3.551	3.575	$6t$	2324	2202	$\frac{1}{4}m$.
Io,	1.769	1.788	$3t$	1733	1761	$\frac{1}{5}m$.

The interesting and valuable communications of Professor Alexander, to the last semi-annual meeting of the National Academy, exhibit various harmonies in the several satellite systems, some of which are closer than my own, others are the same, and others are not so close. He recognizes the important influences of linear centres ($\frac{1}{2}$), centres of linear oscillation ($\frac{2}{3}$, $\frac{1}{3}$), centres of atmospheric dissociation $\left(\frac{n}{n+1}\right)$, mean or extreme apsidal distances, mean eccentricities, and a resisting medium, to all of which I called attention five or six years ago.[*] He thus obtains a planetary series of great symmetry and beauty, but it is neither so close in its general approximations, so broad in its indications, nor so simple in its law, as my series of harmonic nodes, determined by the overshadowing influence of Jupiter.[†] His figures, however, in connection with my own. show that the law of simple harmonic interferences is universally operative, between adjacent planets and satellites, as well as in the systematic subordination of whole groups to more widely controlling masses.

I quite agree with Professor Alexander, in thinking that the relations of the mean distances, detailed in his "Harmonies,"[‡] belong to a very ancient and probably formative state of the system; while those of the extreme distances, as also Stockwell's curious relations between the perihelia and nodes of the outer planets,[§] have been brought about by subsequent perturbations. According to the nebular hypothesis, we might naturally look, when rotation was first established, for arrangements determined by centres of spherical gravity, inertia and oscillation. But as soon as nucleal points appeared, corresponding linear centres began to be operative, and their influence must have become more and more prevalent as condensation went on, leading to the many consequences which I have already pointed out, as well as to many others, the discovery of which will doubtless reward the labors of future investigators. Evidences of perturbative action originating since the establishment of the terrestrial nucleus, seem to be given by the following equations:

$$\frac{n}{n_1} = \frac{\delta_1}{\delta} \tag{7}$$

$$\left(\frac{\delta_2}{\delta_1}\right)^3 (f_1 r_1)^{\frac{1}{2}} = \lambda \tag{8}$$

In these equations $n_1 =$ the special coefficient of Jupiter's dissociative velocity $(n_1 \pi \sqrt{f_1 r_1})$: $\delta_1 =$ Jupiter's secular perihelion distance from the Sun; $\delta_2 =$ Uranus's mean distance from Sun; $(f_1 r_1)^{\frac{1}{2}} =$ limit of satellite-velocity at Jupiter. In view of the many pointings which we thus find towards the limiting velocity of light, it seems probable that the solar-dissociative velocity is still continually efficient, through the combined influences of virtual fall and elasticity, in maintaining the gaseous structure of the Sun. Alexander's relations between Saturn's moons and belts indicate a similar gaseous structure in the belted planet; but even in the Saturnian system my harmonic series gives closer approximations to actual lunar distances, except in the cases of Titan and Tethys, than Alexander's series, which represents centres of atmospheric dissociation, thus doubly confirming the hypothesis that centres of spheroidal activity are first operative, and that afterwards, linear centres modify and extend the primitive harmonies. Titan is Saturn's giant moon. The ratio of distance to planetary radius, for Tethys, is the same as the ratio between the limiting satellite-velocities of Jupiter and Earth.

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[*] *Ante*, vols. xii, 406-7, 412, 520; xiii, 146, 196 (11); xiv, 655, etc.

[†] *Ante*, xiii, 196 (11); 237-9.

[‡] Smithsonian Contributions, 280.

[§] Smithsonian Contributions, 232, p. xiv.

Stated Meeting, Feb. 1, 1878.

Present, 11 members.

Vice-President, Mr. E. K. PRICE, in the Chair.

Letters accepting membership were received from Mr. Asaph Hall, dated U. S. N. Obs., Washington, Jan. 22; Mr. John Price Wetherill, 430 Walnut street, Philadelphia, Jan. 23; Prof. I. C. White, Morgantown, W. Va., University, Jan. 24; and Mr. J. F. Mansfield, Cannelton, Beaver Co., Pa., Jan. 25, 1878.

A letter of envoy was received from Dr. Lloyd, of Dublin, Ireland.

Donations to the Library were received from the Imp. Academy of Prussia; the Belgian Entomological Society; the Revue Politique; London Nature; Harvard College Observatory; Silliman's Journal; the Coast Survey; Min. de Fomento, Mexico; and Dr. B. F. Gould, of Cordova.

Applications and inquiries respecting the Coal Slack Premium were received and referred.

A letter was received from Mr. Alex. Wilcocks, dated Donaldsonville, Louisiana, Jan. 24, 1878, giving an account of the shadows without penumbra cast by the planet Venus.

A letter relating to a bust of John Vaughn was received from Jos. Fry Mogridge, dated Philadelphia, Jan. 26, 1878.

On motion the use of the Hall was granted to the American Institute of Mining Engineers, at 8 P. M., Feb. 26.

Prof. Cope offered for publication in the Transactions a description of fossil remains found in caves in the Island of Anguilla, and read the concluding pages. He proposed for it several lithographic plates, and said that this concluded and completed his previously published memoir on the subject. On motion, the paper was referred to Dr. Horn, Mr. B. V. Marsh, of Philadelphia, and Dr. Daniel G. Brinton, as a committee to report.

Dr. LeConte presented for publication in the Proceedings, as the first of a series, a paper entitled "On the Coleoptera of Florida, by Mr. E. A. Schwarz, of Detroit," which went by regular reference to the board of Secretaries, to be reserved until other papers of the series were received and presented for publication at the convenience of the Society. Dr. Le Conte read a summary of the places where the collections were made.

Mr. Briggs communicated his results in discussing the question where and how the heat generated by a gas burner disperses itself.

In a recent investigation of the chemical and physical properties of ordinary coal gas and its products of combustion, which was made in preparing a statement exhibiting the various relations of chemical changes and heat effects, attendant upon gas lighting, the results of which were intended to be applicable to the heating and ventilation of habitable rooms, has given a value for the heat evolved by burning of coal gas, of so large amount, that it is difficult to account for the dispersal of this heat, at all in accordance with the common observation of the result of gas burning. No facts in physics are so positively established as the heat effects upon bodies, and the determinations of Favre and Silbermann and Regnault have been corroborated by numerous examiners, and are accepted by all physicists. The combustion of coal gas, as it is consumed in lighting, is so nearly a perfect one, with the products of H_2O and CO_2 completely effected, that it must be asserted that the full equivalent of heat due to the chemical combination of the entire Hydrogen and Carbon or Carbonic oxide is produced by the burning. The coal gas itself may be taken as having a specific gravity of 0.426, which gives at 70° a weight of 0.0319 lbs. per cubic foot. Careful computation gives about 19,450 units of heat as the effect of burning one pound, or 622 units as the effect of one cubic foot, and it follows that a four foot gas burner, that is such a burner as will burn four cubic feet in one hour, will produce 2488 units of heat. Taking an extreme case of lighting, a small bed-room which may be assumed to have a floor area of about 100 square feet (that is 8′×12′ or 10′×10′ on the floor) and to be 8 feet in height of walls, thus having a cubic capacity of 800 feet; this room would be appropriately lighted by a single gas burner, consuming four cubic feet per hour. If it could be imagined that the room was closed against the admission of any fresh air whatever, and that the air at the commencement of the experiment was at 70° Fah. with 60 per cent. of humidity, and besides these conditions, that no loss of heat occurred from the enclosing surfaces, floor, walls, ceiling, doors or windows, then at the end of an hour's time the following changes in the air would have occurred : 2.42 cubic feet of carbonic acid, and 0.253 pound, = 5.42 cubic feet of aqueous vapor would have been generated, while 4.91 cubic feet of oxygen would have been taken up ; and 2488 heat units would have been produced. The changes are as follows :

		Air at commencement, cu. ft.	Change during hour, cu. ft.	Air at end of one hour, cu. ft.
O		157.53	— 4.91	152.62
N		630.13	....	630.13
CO_2 @ 4 to 10,000		0.32	+ 2.42	2.74
H_2O lbs.	0.56	12.02	+ 5.42 (0.253 lbs.)	17.44
		800.		
Gas		4.		
		804.		803.03
Temperature		70°	= 174.2° (2488 units)	244.2° !!!

The figures for reduction of the 2488 units are as follows: 800 cubic feet of air at 0.075 lbs. per foot (weight at 70°) = 60 lbs. multipled by specific heat of air, 0.238 = 14.28 and $\frac{2488}{14.28}$ = 174.2.° This result might be amended by computation of the relation of the pressure and temperature for the supposed constant volume of air in the room, but it is too preposterous to need further estimate.

It might be argued that the condition of a closed, perfect heat-retaining room is not a supposable one, and I will proceed to compare the effect of this quantity of heat in similar room where the loss of heat is an ascertainable quantity, taking the same room of 800 cubic feet capacity. Such a room, with an outer wall exposure of not over one-sixth its enclosing surface (the one side of a cube), which outer wall has the usual proportion of window surface and presents a mean aspect to the points of the compass (W. or E. about), will be heated by currents of air coming from steam heated surfaces when one foot of surface is provided for each 80 cubic feet of contents. A temperature of 70° will be maintained within the room against an out-door temperature of zero with this ratio of surface.

In performance of this warming the steam surface of ten square feet may derive its air from out of doors at zero, and there will be furnished in the room three cubic feet of air at the temperature of 100° (heated from zero) each minute for each square foot of steam surface, or 30 cubic feet of air in all, heated at 100,° will supply heat for this room. The room is taken at 70°, and consequently 30° of the heated air will have been expended each minute in heating it, or 900 air feet units—900 × 0.238 × 0.075 = 16 units of heat per minute × 60 = 960 units per hour. These figures are gross approximations of actual heat effects of steam heated surfaces, or of capacity to heat a room against losses from the walls, etc., but they are practical in representing what is sure to be accomplished in house warming and ventilation, and they exhibit conclusively that, unless some other laws of heat from gas lights exist than those which radiate or communicate to the air by convection, we must look for a considerable reduction in the heat-producing effect from what is deduced from rigorous application of the established laws of heat of combustion. It is certain that a four foot burner does not give out nearly three times as much heat as will heat a small room on the coldest day of winter.

Prof. Cope exhibited a roughly mounted fossil under jaw of a large extinct mammal obtained by himself in Colorado, in 1873, and described its peculiarities and classical value, as well as the difficult circumstances in which it was secured.

Pending nominations Nos. 852 and 853 were read, and the meeting was adjourned.

Stated Meeting, Feb. 15, 1878.

Present, 14 members.

Vice-President, Mr. **Fraley**, in the Chair.

Letters of acknowledgment were received from the R. Society at Upsal, Oct. 15 (96, 98); Phys. Society, Berlin, June 3, '77 (92 to 95, and XV, ii); R. I. Academy, Vienna, Feb. 22, '77 (92 to 95 and 97); Nat. Hist. Society at Emden, Nov. 7, '77 (92, 92, 96 to 99); Royal Society, London (99).

Letters of envoy were received from the Central Observatory at St. Petersburg, Jan., 1878; Royal Society at Upsal, Oct. 15, 1877; Physical Society, Berlin, June 3, '77; Royal Academy, Vienna, Aug. 7, '77; Swiss Society at Berne, Sept., '77; Meteorological Office, London, Jan., 1878; and the Office of the Chief of U. S. Engineers, Washington, D. C., Feb. 11, 1878.

Donations for the library were received from the Academies at Vienna, Berlin and Brussels; the Royal Society of New South Wales; Physical Observatory, at St. Petersburg; Royal Societies at Upsal, Copenhagen and London; M. Joachim Barrande of Prag; Dr. Giebel of Halle; Physical Society at Berlin; Societies at Emden, Görlitz, Ulm, St. Gall, and Basel; M. Henri de Saussure; the Geographical Society and Revue Politique, at Paris; the Commercial Geographical Society of Bordeaux; the Linnean and Astronomical Societies, Victoria Institute, Society of Arts, and London Nature; the Royal Observatory at Greenwich; the Lords of Admiralty; Dr. Humphrey Lloyd; Nova Scotia Institute, at Halifax; Franklin Institute, Penn Monthly, College of Pharmacy, Medical News; Smithsonian Institution; Chief of U. S. Engineers; Signal Service Office; Librarian of Congress, and Dr. Geo. Engelmann, of St. Louis.

Mr. Lesley communicated part of a letter from Mr. Leo. Lesquereux, of Columbus, Palæobotanist of the Geological Survey of Pennsylvania, relating a discovery by Mr. Mansfield, in his coal mines near Darlington, Beaver Co. Pa. of the flowers and leaves attached to the stems of *Cordaites*.

> "Sternberg in 1835 first found a stem with leaves attached; on which specimen, Corda in 1845 made his celebrated analysis of *Flabelaria borassifolia*. One other specimen was found by Lesquereux, near Pottsville, in 1858. Recently Grand'Eury's discoveries have enabled him to publish last fall his splendid monograph of the *Cordaites* in his Carboniferous Flora. Mr. Mansfield has now obtained a splendid series of branches with leaves, and even with leaves and flowers, representing in well defined characters numerous species, and a new section of this family unknown to Grand'Eury; so that we now have not only the types of the French author, but other and some new ones far more clearly illustrating the relation of this remarkable group."

Mr. Lesley proposed to read Mr. Lesquereux's descriptions of his new forms (represented on nine plates, now being drawn on stone) at the next meeting.

Mr. Lesley exhibited what appears to be an *Orthoceras* cast in a matrix of schist, lent for examination by Dr. Chas. H. Stubbs to Prof. Frazer, Assistant in charge of the Survey of Lancaster County, said to have been found at Frazer's Point, on the Susquehanna one mile south of the Maryland State line.

Dr Cresson exhibited specimens of large moths: 1. *Samia Cecropia*, native, feeding on oak leaves; 2. *Samia cynthia*, male and female, from China, feeding on Ailanthus leaves; 3. *Actia luna*, green moth, feeding on the cucumber tree—with their cocoons—prepared by Dr. Samuel Chamberlain, who proposes to introduce the *general* culture of these moths for the purpose of establishing a home manufacture of silk.

The minutes of the last meeting of the Board of Officers were read.

Pending nominations 852 and 853 were read.

Mr. Fraley reported the receipt of the last interest on the Michaux Legacy, due Jan. 1, 1878.

And the Society was adjourned.

Stated Meeting, March 1, 1878.

Present, 11 members.

Secretary, Dr. LeConte, in the Chair.

Letters accepting membership were received from Mr. C. H. F. Peters, dated Hamilton College, Clinton, N. Y., Jan. 28; Mr. F. A. March, dated Lafayette College, Easton, Pa., Feb. 4; Mr. Simon Newcomb, Washington, D. C., Feb. 5; and Mr. Elisha Gray, office of the Western Electric Manufacturing Co., Chicago, Ill., Feb. 6, 1878.

A circular letter was received from the Bataviaash Genootschap van Kunsten en Wetenschappen, dated Batavia, Dec. 16, 1877, announcing the celebration of the Centennial Anniversary of the foundation of the Society on the 24th of April, 1878, and extending an invitation to this Society to participate in the occasion.

A letter of acknowledgment was received from the Royal Academy of Lisbon, dated Dec. 26, 1877 (97).

A letter of envoy was received from the Department of the Interior, dated Washington, D. C., Feb. 16, 1878.

Donations for the Library were received from the Ed. Revue Politique, the Meteorological Office, London; Lord Lindsay, Aberdeen; Ed. Canadian Journal, Toronto; Ed. Boston Nat. Hist. Society; Managers of the Germantown Dispensary; House of Refuge; Social Science Association; Ed. Journal of Prison Discipline, Philadelphia; Department of State and Interior, and U. S. Naval Observatory; Academy of Sciences, St. Louis; and Min. de Fomento and C. Meteorological Observatory, Mexico.

A medal of Mr. Peabody was received for the Cabinet from the officers of the U. S. Mint, ordered by the Peabody Education Fund, and given to the Society by Mr. Robert C. Winthrop, No. 90 Marlborough street, Boston, bearing the effigy of George Peabody, with the inscription, "George Peabody, born the 18th of February, 1795, died 4th November, 1869," and on the reverse, "Education, a debt due from present to future generations." The trustees of the Peabody Education Fund."

The death of Henri Victor Regnault of Paris, Jan. 21, 1878, aged 68 years, was announced by the Secretary.

The death of Paolo Angelo Secchi, at Rome, Feb. 26, 1878, was announced by the Secretary.

Letters respecting inventions for utilizing coal slack were received from Mr. Frank Peppard, Basking Ridge, New Jersey, and from Mr. L. Rees, with specimens, Feb. 26, 1878. Referred to committee.

A communication, entitled "On the Aerolitic Epoch of Nov. 12–13," was read from Daniel Kirkwood. (Page 339.)

The Secretary announced the reception of Prof. Lesquereux's MSS. communication, mentioned at the last meeting. (See page 315.)

The Secretary laid upon the table copies of No. 100, of the Proceedings just published, with accompanying list of surviving members.

Prof. Chase made a communication "On Criteria of the Nebular Hypothesis."

Prof. Cope communicated a paper "On the Columella and Stapes in North American Turtles," by Miss Sarah P. Monks, with two 8° plates. (See page 335.)

Prof. Cope communicated a "Notice of the discovery of the position of the crural processes in the genus *Atrypa*," by Mr. Wm. Ginley. (See page 338.)

Dr. McQuillen described a case of the extirpation of nearly all of the cerebrum of a pigeon by himself, and desired to place on record the fact that the subject not only survived the operation 24 days, but gradually regained its usual powers and habits of flight and was able to feed itself and drink. Only one such case is on record. He advocated the propriety and usefulness of such operations from the acknowledged existing uncertainties of the science.

Pending nominations 852, 853 were read.

And the meeting was adjourned.

On the Cordaites and their related generic divisions, in the Carboniferous formation of the United States.

BY L. LESQUEREUX.

(*Read before the American Philosophical Society, March* 1, 1878.)

NŒGGERATHIÆ.

This family of plants was established by Brongniart on a species of Sternberg, *Næggerathia foliosa,* described in Flora der Vorwelt, II, p. 28, Pl. XX, already in 1852. The species is represented by a slender stem or rachis, bearing obovate, alternate pinnules, attached to the rachis by a narrowed base, with simple, straight, dichotomous nerves, slightly projecting at the borders. This plant whose relation was not recognized by Sternberg has not been found since. Gœppert, who received specimens from Sternberg, described and figured it again in his Gattungen, and considered it as a fern related to *Cyclopteris.* Brongniart, however, comparing it to species of *Zamiæ,* he placed it between the *Cicadæ* and the *Conifers,* a place which seems legitimate. The large number of species described since as *Næggerathia* are all of uncertain affinity, and apparently referable to the following generic division, that of the *Cordaites;* at least, I admit them into it. The leaves of *Næggerathia* are two sided, those of the *Cordaites* are in spiral order; we have none of the first.

Brongniart in his Tableau des Genres, 1849, established, under the name *Pychnophyllum,* a second genus of the same family from another of Sternberg's species, *Flabellaria borassifolia;* while about at the same time Unger described it as *Cordaites borassifolius,* 1850. Sternberg had referred his plant to the Palms, but Corda, who in 1845, admirably defined its characters by microscopical analysis of its structure in his Beiträge, p. 44, Pl. XXIV and XXV, separated it from the Palms, and found its affinity to *Lomatofloios* and *Sigillaria,* comparing it to species of *Dracæna* of our time. The preservation of the name of *Cordaites,* in deference to the admirable work of Corda, is indeed legitimate, and has been until now generally preserved.

GROUP OF CORDAITES.

Perhaps no remains are more generally and abundantly found in the coal measures, from the Devonian to the Permian, than those of *Cordaites.* They are generally fragments of ribbon-like long leaves, most rarely found in connection with the stems; for since Sternberg whose specimens were used by Corda for his illustration of stems and leaves, I do not know that until recently any specimens of *Cordaites* have been found anywhere with leaves connected to a stem, except one figured here which I discovered years ago in the upper anthracite Salem vein, near Pottsville, Pennsylvania. Even single leaves of *Cordaites* are rarely found entire, or in their whole length. In some coal beds of Illinois layers of shale one foot thick, or more, are composed, so to say, of those leaves heaped and pressed one upon another without any other kind of vegetable remains. There, also, I could never obtain a fragment of stem nor any kind of fruits which could be used for completing in some way the description of the characters of the genus.

Now from the specimens recently published in the splendid Coal Flora of Grand'Eury, and from those which are described and figured here, and which give, perhaps, still more evidence in regard to the relation of the *Cordaites*, the genus may be characterized as follows:

CORDAITES Ung.

Stems or branches with a large medular canal, marked outside by transverse narrow close ribs, sometimes joined by divisions, covered with double or triple layers of bark, recognized in the fossil state by two or more thin layers of coal, that of the surface being more or less distinctly marked by semi-lunar inflated scar of leaves, and bearing also, as seen from our specimens, oblique divisions or branchlets. The naked stems have been generally described under the name of *Artisia* or *Sternbergia*, when found deprived of the bark. Leaves in spiral order, more or less distant, sometimes imbricated, ribbon-like, of various lengths and width, mostly linear or gradually enlarging upwards, generally obtuse, sometimes undulate, and more or less deeply split at the top, curving to and somewhat inflated at the sessile or semi-embracing base, marked lengthwise with parallel primary and secondary nerves or lines more or less distinct, generally more distant in the middle of the leaves, and somewhat inflated toward the base. According to the enlarging progress of the leaves towards the point, the nerves divide by splitting, a division which is rarely observable.

The stems bear racemes of flowers, rarely found, however, going out of the axils of the leaves. Two kinds are figured here, seemingly bearing, one male, the other fertile flowers. They evidently represent, in part at least, the so-called *Antholites*, which until now have been separately considered without positive reference.

The fruits of *Cordaites* are described by Grand'Eury under the names of *Cordaicarpus*, *Diplotesta*, *Carpolithes Grand'Eurianus*, *C. avellanus*, and *C. Gutbieri;* none of which, except the two last species have been found in connection with the specimens published here, or in the same clayed cannel coal wherefrom they are derived. The more common species of fruits of this locality are figured here as future points of comparison.

No silicified remains of these plants have as yet been found in the American coal measures, and therefore, anatomical and microscopical researches in regard to their internal structure are here impossible. The only analysis made from a silicified stem, is that by Corda, loc. cit. European authors, especially Gœppert, Weiss and Grand'Eury, have discussed at length the characters of the *Cordaites* and their relation. This consideration, pursued from different points of view, though very instructive and interesting, cannot find place here.

We owe to the systematic researches of Mr. I. F. Mansfield, of Cannelton, the discovery of a large number of specimens of this genus which have been mostly used for the figures and descriptions of the carboniferous flora. They supply a considerable amount of evidence on the relation of various forms which had been from fragments referred to different generic divisions or even to different families, and also on the peculiar mode of vegetation of these plants. Certainly the vegetable paleontology of our coal is greatly indebted to this ardent, careful and very experienced collector.

The American species of *Cordaites*, as far as we know them up to the present time, are referable to different divisions which I have merely named in the margin.

[CRASSIFOLIÆ.] CORDAITES VALIDUS, sp. nov.

Pl. XLVII, fig. 1, 2.*

Leaves thick, very long, linear, as far as shown by the fragments, thirty-five centimeters long, half embracing the stem at the base, five to eight centimeters broad, slightly enlarged in turning to the inflated point of attachment whose scar is subcordate, narrowly, nearly equally and obscurely striate on the upper surface, where the veins, seven or eight per millimeter, are immersed into the epidermis; more distinctly marked on the lower surface where they are obtuse or keeled, irregular in distance, three to five per millimeter, sometimes with an intermediate secondary vein, more generally with an obtuse furrow between them.

The fragment of stem figured is more coarsely and irregularly striate than the leaves, the striæ being here and there inflated, thus irregular in size, so that at first sight or without glass, the nerves do not appear continuous. They are so, however, two, sometimes three in one millimeter, even one millimeter apart. The coaly layer of the bark is about one millimeter thick, sometimes more. The same thickness of coal takes the place of the leaves upon the lower somewhat concave surface, under a coating which seems intermediate between the upper and lower faces of the leaves, and thus represents its thickness diminished by compression.

The figure of the specimen seems to show the base of the leaf as decurrent on one side. But the branch is broken, and presents the face opposite to the point of attachment, the apparent decurring base being merely the turning of the leaf to the point of attachment behind, and its laceration from the broken stem. Fig. 2, represents the base of the leaves when detached from the stem, and flattened by compression. It is irregularly, deeply undulate-laciniate, with the base of the laciniæ inflated, and the intervals corresponding with thick fascicles of nerves, dilated above. Fig. 2, shows the scar of a leaf upon a larger stem; its form and width has no correspondent in any of those figured by Grand'Eury in his Flore Carbonifere for stems of *Cordaites*. This author, however, seems to have seen leaves like the one described, for he says in a note on a sub-species of *C. borassifolius*, under the sub-specific name of *crassifolius*, loc. cit., p. 216. "I do not know as yet if I can refer to the same type some more consistent thicker leaves of which one of the faces is anguloso-striate by stronger and alternate thinner veins, but of which the other is finely and equally striate." This remark describes the nervation of our species. I should, therefore, have preserved Grand'Eury's name, if the characters of these leaves, especially the mode of attachment, had not been so far different from that of the following section, and especially if the French author had given a description instead of a remark.

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*The numbers of the plates are not definitive. They are indicated merely for reference to a few copies of the plates furnished, before lettering, to the Proceedings of the American Philosophical Society of Philadelphia out of the edition in preparation for publication in the volume entitled "Report of Progress of the Second Geological Survey of Pennsylvania; Fossil Flora, &c."

Habitat. Cannelton, Beaver County, Pennsylvania, I. F. Mansfield.

CORDAITES CRASSUS, sp. nov.

Nœggerathia crassa? Gœpp. Foss. fl. der Ueberganzsgebirges, p. 220, Pl. XL.

The specimens appear rather to represent a large stem of the *Nœggerathia* or of *Cordiates* than leaves. Fragments of the same character are found in the coal measures of Pennsylvania. Years ago I sent to Prof. Brongniart, among other specimens, a leaf or stem similar to that described by Gœppert, but with narrower striæ. Its reference was not mentioned by that celebrated author. These fragments vary in thickness, from two to five millimeters, are coarsely but equally striate, resembling flattened stems of *Calamites*, without articulation, and with thinner striæ-like fascicles of nerves inflated at some places, or buried into a thick epidermis.

[GRANDIFOLIÆ.] CORDAITES GRANDIFOLIUS, sp. nov.

Pl. XLVIII, fig. 1, 2, 2*a*.

Leaves large, of a thick texture, gradually and rapidly enlarging upwards and fan-like, from a narrow, semi-lunar base, thirty centimeters long or more, round-truncate or rounded and undulately lobed and split at the top; nervation double; primary nerves obtuse, three to four in one millimeter, dichotomous or splitting, inflated toward the base, with one often indistinct intermediate vein, becoming more marked near the base.

Of this species I have not seen any stems, and all the leaves which I had for examination have the same truncate narrow base, one of them being cut at the point of attachment in the semi-lunar form of the leaves of *Cordaites*. Among the fine specimens sent by Mr. R. D. Lacoe, of Pittston, most of which are too large for illustration in our plates, the outspreading upwards is marked in different degrees. One of the leaves, for example, is thirty-eight centimeters long, gradually enlarging to the rounded top, where it is sixteen centimeters wide, undulate and split in short laciniæ, like fig. 1.

Another leaf with the base six millimeters broad, truncate, but concave as to a point of attachment, is thirty-two centimeters long, and fifteen centimeters broad at the top or there nearly half as broad as long.

The only relation I find to this species is with *Nœggerathia obliqua* and

N. Beinertiana Gœpp., Gatt. liv. 5–6, p. 108, Pl. XII, fig. 2 and 3, representing much smaller leaves whose description is insufficient. Of the first, comparing it to *N. foliosa*, the author says that the nerves are dichotomous, and more distinct; of the other that they are very close (*creberrimi*), and dichotomous. The first is from the Devonian (grauwackea), the other from the Carboniferous. As far as seen from the figure and the descriptions, the characters of both do not agree with those of this species. Of the first, Schimper supposes that it may be a leaflet of a *Macropterigium;* of the second he says nothing. *N. Beinertiana,* described also by Geinitz, is said to have veins of equal thickness, wrinkled across, two characters at variance with the nervation of these leaves, where besides the unequality of the nerves, the cross wrinkles are less marked than in any other species of this genus, indeed undistinguishable even with a strong glass.

Habitat. Pittston ; intra-conglomerate measures, R. D. Lacoe.

[COMMUNES.]

This section might be subdivided into two, one for the species with large leaves, more generally found in the middle coal measures ; the other for the narrow leaved species, which appear related to those described by Grand'Eury, under the name of *Poa-cordaites.* I cannot, however, find, either in the nervations, or in the basilar form of the point of attachment of the leaves, any persistent characters which could enable me to distinctly separate them.

CORDAITES BORASSIFOLIUS Ung.

Pl. XLVII, fig. 3, 3*a*, 3*b*.

Leaves generally large from five to eight millimeters broad in the middle, where they appear the widest, gradually and slightly narrowing upward and downward, sublinear, obtuse or truncate, and generally more or less deeply split at the top, slightly contracted at the semi-lunar somewhat inflated base. Nervation indistinct to the naked eyes, close, five to seven primary nerves in one millimeter, and generally one intermediate thin veinlet, surface marked by cross wrinkles, more distinct than in the former species.

As figured by Corda, who has exactly marked the characters of nervation, and of the areolation, the leaves are all obtuse and shorter than I have generally found them. The branch which the German author has figured, however, is a young one ; the leaves are merely those of the tops of the branches. I have seen in Kentucky, near Amanda furnace, a bed of clay composed mostly of remains of this species, where amongst an immense number of fragments, I found also some large top leaves five to six centimeters broad, some very obtuse, half round, some also split into laciniæ in the middle, others narrowed at the top, like that of our figure.

The one figured here is cut in two, the middle part being left out for want of space. It measures in its whole, forty-five centimeters in length, and six centimeters width, in the middle ; the lines 3^c and 3^d mark the diameter of the leaf.

These leaves are found in most of the beds of our Carboniferous measures from the Millstone Grit to the Pittsburgh coal, where they are abundant. Not rare at Cannelton.

CORDAITES COMMUNIS, sp. nov.

Leaves of various size, generally smaller than those of the former species, more evidently and generally attenuated to the base; the largest leaf seen of this species is twenty-two centimeters long, and thirty-seven millimeters wide at or near the top where it is broken; fifteen millimeters broad just above the point of attachment, with border generally recurved. The upper surface is covered with a thick epidermis with distinct cross wrinkles. Primary nerves about three in two millimeters, obtuse and more obscure at the upper surface, distinct in the lower, with two to four intermediate veins. The nervation of these leaves is sufficient to separate them from the former species.

One of the specimens represents a branch with leaves attached to it, and semilunar scars of those which have been destroyed. It bears also an unfolding branch, about in the same position as the one figured Pl. XLIX, fig. 2, but with shorter leaves, two centimeters long, more closely imbricated and more enlarged at the base, where they measure five to six millimeters, and small cones (one only is distinct) with imbricated scales exactly like *Cordianthus gemmifer*, of Grand'Eury, as figured Pl. XXV, for his illustration of the Cordaites. It is not possible to see the mode of attachment of the cone.

Besides the character of the leaves the species differs from the former and from any of those described here by the thick bark covering its stem. It is nearly one millimeter thick, though the stems are flattened by compression.

Habitat, Clinton, Missouri; found and communicated by Dr. J. H. Britts.

CORDAITES DIVERSIFOLIUS, sp. nov.

Pl. XLVIII, fig. 3, 3*a*.

Leaves narrow, linear, half embracing the stem at the point of attachment, twelve to fifteen millimeters broad, curved backward, except those of the top, which are closely imbricated, and in tuft. Surface distinctly marked by the nervation so that the primary nerves may be counted without glass. These are generally equal, obtuse, three to four in one millimeter, with very thin scarcely perceptible intermediate veinlets.

The specimen figured and mentioned above as the first found in this country with leaves attached to the stems, is from the Salem Vein, near Pottsville. The point of attachment is figured too large, the base being obscured or somewhat covered by fragments of imbricated leaves. I have from this species separate leaves from Clinton, Missouri, one of which measures at the point of attachment seven millimeters, and is enlarged above it to eleven millimeters.

C. angustifolius, Lsqx. Ills. Rept., II, p. 413 (1866).* Name preoccupied by Dawson in Canadian Naturalist, 1861, p. 10.

It farther and gradually increases in width to seventeen millimeters at the broken end, eleven centimeters from the base. Other leaves from the same locality are exactly linear, seventeen millimeters in diameter, while others still, fifteen millimeters above the point of attachment, gradually diminish in width upwards to fifteen millimeters. I remark their dimensions to show the variety of size of leaves of this genus, not merely in comparison with each other but in different parts of their length.

I refer to this species leaves found in large numbers at the same locality as the specimen figured, some of which are flat and linear, others with borders curved inside or half cylindrical, others still true cylinders, not larger than a goose-quill, seemingly coming out of a pedicel or stem, as they are often found in bundles and enlarging upwards in proportion as the borders become more and more open and flattened. The nervation is of the same type, the epidermis thick; they represent in their cross sections an oval line, like figure 3 of Grand'Eury, Pl. XVIII.

Habitat. Upper coal measures of Pennsylvania, Lower coal measures of Missouri; middle and lower coal of Illinois, where it abounds, at Colchester especially, St. John and Du Quoin.

CORDAITES MANSFIELDI, sp. nov.

Pl. XLIX, fig. 1, 1*b*, 2. *Pl. XLVII, fig.* 4, 4*b*.

Stem covered with a thin bark of polished coal, marked by numerous scars of the convex base of leaves, either imbricated or more or less distant, disposed in spiral. Leaves long, erect, nearly exactly linear, gradually diminishing toward the top to an obtuse point, averaging fifteen millimeters in diameter, distinctly and distantly nerved; primary nerves fifteen to eighteen in one centimeter, with two to four intermediate veins; surface rugose across as in the former species; branches oblique with imbricated leaves of proportionate size. Flowers composed of four sepaloid involucres, borne upon simple flexuous pedicels, to which they are attached by short peduncles.

As seen from the splendid specimen figured here and from a number of others quite as remarkably well preserved, the species is characterized by its long, erect, linear leaves, whose surface is marked by a strong nervation (1^a enlarged double, 1^b enlarged four times) rounded and narrowed to the point of attachment, reduced to half the diameter of the leaves, perfectly entire and obtusely pointed. The stems are covered with a thin coating of coaly, shining bark, where the scars are distinctly marked, but no more so than upon the subcortical surface. The branches apparently form the axils of the leaves, one of which is seen, fig. 2, bears leaves proportionate to their length and their age, imbricated, linear-lanceolate, obtusely pointed, with a nervation of the same character, reduced, of course, to proportionate dimensions by the size of the leaves. Another specimen bears a branch two to three centimeters thick, diverging in the same degree as that of the figure, twelve centimeters long, with leaves proportionate in size, the largest already fifteen centimeters long, all imbricated, linear-lanceolate, with the borders incurved, especially towards the top, which thus appear acuminate. The nervation has equally the character of the large leaves, the primary veins being one half to three-fourths of a millimeter distant, with two or three intermediate distinct vinelets.

Under the name of *Cordianthus simplex,* I refer the stem bearing flowers, Pl. XLVII, fig. 4, 4ᵃ, to this species especially because the specimens were found in the same shale and in proximity to those bearing leaves, though not in connection with them. Of these stems one is entirely naked, without leaves or flowers; the other figured here shows some difference in its slightly thicker coaly surface and in the absence of distinct leaf scars. These, however, may have been obliterated by longer process of decomposition; for the racemes of flowers are flattened by compression and irregularly flexuous, with their vascular filaments distinct, as if the branches had been in an advanced state of maceration. The flowers, which appear to be male flowers and borne upon a short peduncle, are mostly turned downward and are composed, as seen fig. 1ᵃ, of three or four involucral, thick, lanceolate, abruptly pointed sepals. The point of attachment of the elongated narrow racemes is round, inflated in the lower part, as seen fig. 4ᵇ. Their position in regard to the leaves is not possibly seen.

Comparing these fructifications to those which have been figured by Grand'Eury, there is a marked difference in this, that all the flowers figured by this author either sterile or fertile are sessile upon the branchlets. It is the same with those figured by Dawson under the name of *Trigonocarpum racemosum* in his Devonian Plants, Quat. Jour. Geol. Soc. vol. XVIII, Pl. XVI, fig. 47, which are referable to *Cordianthus baccifer* of Grand'Eury; those also of Weiss, Foss. flora, p. 195, fig. 1, representing *Cordianthus gemmifer.* A point of likeness only is found for the form of the flowers attached to a short pedicel and the thick raceme in Sternb. Fl. der Vorw., Pl. XXVI, fig. 2. This figure, though described without reference as *plantula debilis,* p. 33, evidently represents flowering branches of *Cordaites.*

Habitat. Cannelton. I. F. Mansfield.

CORDAITES GRACILIS, sp. nov.

Pl. XLVIII, fig. 4–4ᵇ.

Stem slender, with a rugose somewhat thick bark; leaves sessile by a narrowed base, open or curved backward, distant, gradually enlarged from the base upwards, sublinear, obtusely truncate at the top; nervation indistinct in the upper corticated surface, which is somewhat rough, primary nerves variable in distance from one millimeter apart to three or four in two millimeters, with one or two, even four, intermediate, very thin veins.

Closely allied to the former by its distinct and distant nervation, it is, however, far distant by the form, the size, the position of its leaves, and its thick, rough bark. The part of stem preserved is seventeen centimeters long, seven millimeters wide at its base, four millimeters at its top, flattened by compression. The leaves are either at right angles to the stem or curved backwards from their point of attachment, nine centimeters long, gradually enlarging from the base, five millimeters, to the top one centimeter wide, where they are rounded and obliquely truncate, the point slightly curved inside or concave as marked in the figure. Fig. 4^b shows the point of attachment of the leaves observed upon another specimen.

Habitat. Morris, Illinois, lowest bed of coal above the Millstone Grit; found by Mr. S. S. Strong. One specimen with broken leaves, but distinct scars, is from Cannelton, by Mr. I. F. Mansfield.

[COSTATÆ.]

Stems or branches irregularly costate by the prolongation of the base of the protuberant leaf scars, whose upper surface is covered by a smooth shining coating of coaly bark.

CORDAITES COSTATUS, sp. nov.

Pl. LI, figs. 1–4.

Stem irregularly costate, leaves narrow, nearly linear, five millimeters broad above the point of attachment, gradually enlarged to nearly one centimeter at the point where they are broken ten centimeters from the base; nervation distinct; primary nerves unequal in distance, three to five in two millimeters, with three or four intermediate vinelets especially distinct on the under surface of the leaves; surface cross wrinkled; flowers narrowly ovate, composed of appressed, imbricated, narrow, linear-lanceolate, acuminate scales, sessile, upon long decurring cylindrical racemes.

The branch, one and a half centimeters broad, bears as basilar support of the leaves, tumescent, reniform scars, fig. 2, narrowed at the base into a linear inflated support, which, after the disruption of the leaves, form, when persistent, narrow, carinate, alternate ridges, becoming sharply keeled and distinct in the old stem, as seen in fig. 3; or when destroyed by maceration, leave a cavity of the same size with elevated borders. The leaves are in an acute angle of divergence from the stem, somewhat loosely imbricated in spiral. Sometimes as seen in *a*, they appear decurrent by a casual flexion of the lower part to the stem.

The flower bearing peduncles are cylindrical, apparently of hard texture, slightly inflated, or like articulate at the point of attachment of the flowers which are sessile or with a very short pedicel. The form of the flowers is very different from that of the ones described from specimens of *C. Mansfieldi* and of *C. communis.*

Habitat. We have three specimens of this fine species found by Mr. I. F. Mansfield, at Cannelton.

[SERPENTES.]

Stems narrow, flexuous or serpentine, abruptly terminating into a large, flat leaf.

CORDAITES SERPENS, sp. nov.

Pl. L, fig. 1–4

Stems narrow, fifteen to twenty-five centimeters thick when compressed, covered with a thin coaly opaque layer of bark, marked by somewhat distant semi-lunar scars of leaves. Leaves at right angles to the stem, sublinear or slightly enlarging upwards, eight to ten millimeters broad, rounded in narrowing to the point of attachment, distinctly veined. Primary nerves nearly at equal distance, effaced towards the borders, three or four in three millimeters, with three to five, more generally three, very thin intermediate secondary veins. Top of stems abruptly terminating into a broad, flat leaf, as broad as the stem, covered with double coating of coaly matter, the upper one somewhat thick, destroyed near the point of conjunction with the stem, but distinctly nerved like the lower one, thick also, whose nervation is of the same character as that of the leaves, the primary veins only a little closer, showing in relief on the under surface, thin, obtusely keeled careens.

The specimens figured elucidate the species as far as it has been possible to see it. In fig. 1, representing the only specimen with leaves, those coming out of the stem, near its point of disruption, are narrower and divided in flexuous, linear-lanceolate, pointed laciniæ, deeply marked by fasciles of veins. In fig. 2, the abrupt termination of the stem is clearly marked in conjunction with the terminal leaf. Fig. 3 has the upper part, the bark, destroyed by maceration. The stem is preserved in its cylindrical state, not compressed, and shows the transverse ribs of *Artisia* perfectly distinct, obtuse. The depression in fig 3, which seems upon the figure as a corrodation or a destruction of the stem by maceration, is an abrupt termination as in fig. 2; for the coating of coaly matter, nerved like that upon the terminal leaf, covers the declivity to the border of the cylinder.

Professor Dawson has a branch of *Sternbergia* or *Artisia*[*] pith, which he says is probably of a *Dadoxylon*, which represents this abrupt termination in a most remarkable manner, the pith being one and a half centimeter thick, terminating in a cone of six or seven gradually smaller rings, the last one only half a centimeter in diameter. (Geol. Survey of Canada, 1871, Pl. III, fig. 28). He supposes also referable to *Dadoxylon* another fragment of the same character, bearing on one side a piece of thick bark as we see it bordering the stem of fig. 3. It is represented in Canadian Naturalist, May 1861, as *Dadoxylon Ouangondianum*, and considered by the author as a conifer.

Fig. 4, of our plate, reduced in size, represents a long stem of this species, flexuous, narrower per places, especially in the middle, somewhat inflated at both extremities; it is fifty centimeters long, varying in width from twelve to twenty-four millimeters, covered with close, tumescent scars of leaves, which are obtusely rhomboidal, six millimeters in horizontal direction, four millimeters in the vertical one, also covered with a thin layer of opaque coaly bark.

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[*] The names are synonymous, referring to those cross ribbed branches which Corda considered as stems of *Lomatophloios*.

This species seems to represent a floating rather than a creeping plant, for no traces of appendages like radicles or their scars can be observed upon any of the specimens. The prolongation of the stem into a broad, flat, thick leaf, seems to indicate that kind of growth in water, as it appears to serve as a support to the plants on the surface of the water.

The cylindrical part of fig. 3, deprived of its thick bark, which is left on both borders, evidently shows, not merely the relation, but the identification of *Cordaites* with *Artisia,* an identification which is still more closely seen upon a number of other larger stems of *Cordaites,* one of them figured Pl. LII, fig. 2. It shows a double layer of bark which, whenever it is destroyed, distinctly exposes the horizontal ribs of *Artisia.* This fragment appears articulate, and marked on one side of the articulation by a large, protuberant scar of a branch, while on the other side it shows the semi-lunar scar of a leaf. No trace of articulation has been until now remarked upon stems of this kind, at least none is mentioned in the work of Grand'Eury, who has so remarkably illustrated this genus. The specimen bears, just near the branch-scar, a bundle of narrow leaves of *Tæniophyllunm contextum.* Pl. LIII, fig. 2,—but the bundle does not touch by its base the scar of the branch, nor does it appear to be in connection with it, and as the specimen, a large piece of shale, is covered with bundles of the same leaves, I do not consider them as related to this stem. Another specimen, a branch twenty-two centimeters long, three and a half centimeters broad, convex or half flattened, whose surface is partly covered with the coaly layer and the distinct semi-lunar scars of leaves, six millimeters broad, shows, where deprived of its bark, or upon more than the two-thirds of its surface, the distinctly marked cross ribs of *Artisia.* These ribs are variable in width from one to two millimeters, parallel, sometimes slightly undulating in their borders, but traversing right across the tumescent obtuse scars of the leaves, without any deviations in their direction, nor any kind of branching which could indicate the passage of vessels of leaves into the subcortical cylinder. On one of the borders of the branch, the bark either flattened, or cut lengthwise like that of Pl. L, fig. 3, is half a centimeter thick. The surface coal layer, however, is not more than one-fourth or scarcely half a millimeter thick. That therefore the *Artisia,* or at least most of the stems described under this name, are the woody cylinder of *Cordaites* is established beyond a doubt by these specimens.

I cannot assert from the examination of my specimens that species of *Artisia* may not be referable to *Dadoxylon* representing *Conifers.* But I have not seen as yet any branches of *Artisia* which might be separated from the *Cordaites;* and if *Artisia* species are found with the characters of the *Conifers,* the *Artisia of Cordaites,* or those described by the authors and referred to plants of different genera, should have the same characters. This has not been positively established.

Grand'Eury refers *Dadoxylom* and its *Artisia* stem to *Cordaites.* Corda has, the first and most carefully, analyzed and described *Artisia* as the pith cylinder of *Lepidophloios*, a genus generally considered in intimate relation to *Lepidodendron* or *Lycopodiaceæ* by Grand'Eury, Goldenberg, Shimper and others; therefore, the reference of *Artisia* to any kind of *Conifers* is as yet, it seems, unauthorized. I have treated the subject with some more details in considering the general characters of the Carboniferous flora.

[FLOWERS AND FRUITS OF CORDAITES.]

Under the name of *Cordianthus*, Grand'Eury has considered as evidently referable to *Cordaites*, the flowering branches known formerly under the name of *Antholithes*. The racemes of flowers described here with *Cordaites mansfieldi*, *C. communis*, and *C. costatus*, evidently prove this relation. For, if they are more slender and less developed than those which have been found separated from the stem, as the *Antholithes*, the characters of these organs are evidently identical. They represent either male flowers, buds covered with imbricated scales, containing merely a powder which may be the pollen; or fertile flowers in small oval or round ovules. Of these we have only the following species referable to male flowers:

CORDIANTHUS GEMMIFER, Gr. d'H.

Pl. XLVII, figs. 5 *and* 6.

Buds sessile, upon a thick, simple raceme, broadly oval; scales imbricated, oval, obtusely pointed.

This species, represented by fig. 5, corresponds to that of fig. 4, Pl. XXVI, of Grand'Eury. The second with longer oval lanceolate, more acute scales of a narrower cone, as represented by fig. 6, corresponds to fig. 6 of the same plate of Grand'Eury.

Of the fertile flowers, *Cordianthus baccifer*, I have not found any. A branch described and figured in the Geological Report of Illinois, IV, p. 427, Pl. XI, fig. 6, under the name of *Schutzia bracteata*, Lesqx., bears on one side of the raceme cones identical by their characters to *Cordianthus gemmifer*, while it has on the other a closed bud or a round tubercle, borne upon a short, inflated pedicel, which appears to represent the round tubercles of *Cordianthus baccifer*. This, therefore, would imply the monoicity of these flowers, while all the specimens published by Grand'Eury and other authors, represent only racemes with either gemmifer or baccifer flowers, and therefore indicate the inflorescence as diœcious. My specimens are not good and distinct enough to authorize a definite conclusion, as the bacciform bud may represent merely the top of a gemmiform one,* whose basilar scales have been destroyed and detached by maceration. The remaining top, however, is exactly globular. By detaching the scales of the gemmifer cones, I found under them a transparent, yellowish membrane, formed of elongated, equilateral, small meshes or areolæ, inclosing or supporting small granules of opaque brown matter. These granules, scarcely the hundreth part of a millimeter in diameter, are of a roundish, irregular polygonal form, agglomerated and separating with difficulty. Their size and irregularity of form prevent us from considering them as spores; they look rather like grains of pollen.

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*Grand'Eury remarks with reason, that these flowers are generally so much altered by decomposition, that it is rarely possible to fix the sex which they represent.

Most of the authors of works on vegetable paleontology have figured and described as *Antholithes*, under different specific names, some of these organs. Already in 1854, Professor Newberry has a representation in the Annals of Science of Cleveland, of three branches, reproduced in the first volume of the Paleontology of the Geological Survey of Ohio. The one Pl. XLI, fig. 1, of this last work, *Antholithes* Pitcairniæ, Lld. and Hutt, is like our fig. 6; the spikelets, however, being naked, or without the linear bracts generally found supporting the flowers of *Cordaites*. As my specimens show part of the flowers without these bracts, this difference is probably due to the degree of maceration to which the plants have been subjected. Fig. 2 is *baccifer*, the ovules being not only sustained by a leafy bractlet, but half inclosed at their base into an involucre. Nutlets of the same kind and form, but much larger, are represented attached to thick branches in fig. 4, as *Cardiocarpon*, while fig. 3, under the name of *Antholithes priscus*, Newby, represents a *Cardianthus gemmifer*, whose upper scales are mixed with leaves apparently originating from under the scales.

All the forms described by the European authors are represented in the splendid plates of Grand'Eury, who has separated, as flowers of *Poa Cordaites* the slender, flower bearing racemes which I have described with *Cordaites mansfieldi* and *C. costatus*.

Of the fruits and nuts referable hypothectically to *Cordaites* the number is considerable. But except the nutlets figured by Newberry, Dawson and Grand'Eury, no larger fruit has been found positively attached to stems or branches of *Cordaites*, nor indeed of any other coal plants. I have figured, Pl. LIV, the fruits most commonly found at Cannelton in shale bearing *Cordaites* remains. They are described with the other kinds of fruits of the coal. These may be compared only to two species of Grand'Eury as remarked above.

Of all the others referred as *Cordaicarpus, Cardiocarpus, Carpolithes*, to *Cordaites* or *Nœggerathia*, there are scarcely any at Cannelton. Geinitz refers *Rhabdocarpus* species to *Nœggerathia*. To *Cordaites principalis* he refers *Carpolithes Cordai*, as yet unknown in our coal measures, while the common fruits of Cannelton, figs. 8 to 11, are most like if not identical to *Cardiocarpon Gutbieri*, which Geinitz does not refer to *Cordaites*; while Grand'Eury names the same species *Cordaicarpus Gutbieri* among the fruits of *Cordaites*. It has a distant likeness to our fig. 8, and therefore all these fruits, fig. 6 to 11, might be hypothetically considered fruits of *Cordaites*, as by transition they seem to represent, either the same, or two closely allied species. It is the only trace of light we have on the subject. The two fruits, fig. 7, are of different type. They are attached to a broken pedicel, and were found also with the *Cordaites* of Cannelton. They are, like the others, described with the fruits of the Carboniferous measures.

CORDAISTROBUS, Lesqx.

Strobile conical, tapering to a point, covered by transversely rhomboidal scars, placed in spiral, bearing narrow linear leaves, with the characters, form and nervation of leaves of *Cordaites*.

The plant from which this genus is established might have been described perhaps as *Cycadoidea* or *Mantellia*, a genus established for the description of stems of Cycas, mostly globular, or conical obtuse, or nest form, all referable to a more recent formation, the Permian. As the leaves are of a different character, as also the reference of this cone to *Cycadæ* is merely indicated and not positively ascertained, I think advisable and more rational to describe it under this new genus, which indicates its relation.

CORDAISTROBUS GRAND'EURYI, sp. nov.

Pl. LIII, fig. 3.

Cone cylindrical from the base to the middle, narrowed upwards and acuminate, borne upon a somewhat thick pedicel or axis equally striate in the length; scars transversely rhomboidal, inflated in the lower part, bearing at the top another smaller rhomboidal scar point of attachment of linear leaves, marked by parallel distinct nerves.

The leaves are short, mostly broken near the point, one only preserved in its whole on one side; of the other, four are left, close to each other, all evidently attached to the rhomboidal scars of the cone. The scars show the spiral disposition of the leaves. The nervation of the leaves seen in 3a, is exactly of the *Cordaites* character. The primary nerves are close, especially toward the borders, and separated by one or two intermediate veins. The axis of the cone, as far as it is seen upon the specimen, is covered by a comparatively thick coaly bark more than half a millimeter thick. It is deeply and regularly striate, the striæ being also obscurely seen along the middle of the cone, even to its point, by compression of the scars, as represented upon the figure.

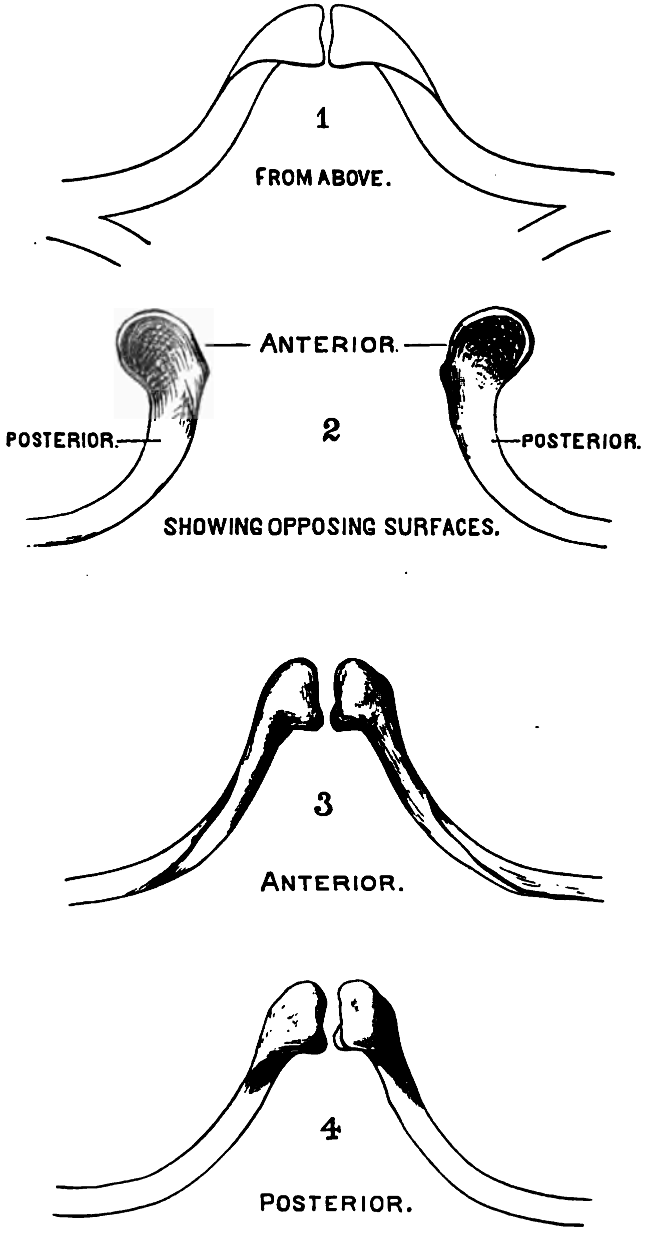
I consider this cone as proving more than any other of the organs described, the relation of *Cordaites* to *Cycadæ*. By the leaves it is a true *Cordaites*; by the scars and their disposition it represents a small stem of *Cycas*. It is, however, difficult to explain its true nature. It does not look like a fruiting cone, and all that is known until now of the stems of *Cordaites* is without relation to this branch. Dr. Newberry has represented, loc. cit., as *Antholithes priscus*, a branch of *Cordianthus*, bearing small recurved gemmifer cones, to which are appended short leaves which seem as originating from under the scales. This is the only organism which might perhaps explain the nature of this strobile by supposing a kind of viviparous vegetation produced directly from the flowering cones of *Cordaites*. Though it may be, that its relation, as remarked above, is clearly marked as a point of connection between *Cordaites* and *Cycadæ*.

Habitat. Cannelton. Mr. I. F. Mansfield.

DICRANOPHYLLUM,? Grand'Eury.

The author has described under this name linear narrow leaves of various length, twice forking at the top, coriaceous, marked with a few thick

Proc. Amer. Philos. Soc., Phila. Vol. XVII. No. 101, p. 337, 1878. Plate 14.



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nerves and intermediate nervilles more or less immersed into the epidermis. These leaves are inserted around small branches upon tumescent small bolsters, whose disposition is in regular spiral, with a rhomboidal section recalling those of the *Lepidodendron*, but formed by the fleshy base of laterally decurring leaves like those of some *Conifers*. He adds that the leaves of one of his species, *D. Gallicum*, do not seem to have been caducous, some remains of them are generally seen even upon the oldest branches, where they have not left any distinct scars. The coaly envelope of the branches is thick, the foliaceous bolsters are soon effaced upon it, as if the bark had increased in thickness in contact with a ligneous increasing body, as in the dicotyledonous.

The description of the stems and of the rhomboidal scars placed in spiral and left upon the branches, and also the fig. 3, of a branch, in Pl. XIV of his flora, corresponds in part with the characters of the cone or branch described above. But the leaves of *Dicranophyllum* are of a different character from that of the *Cordaites*, and, therefore, the author has separated this genus from the order of the *Cordaites*.

The organism, which from its leaves I consider as a *Dicranophyllum*, differs in many points of the above description, but some of its characters are so clearly corresponding that I do not find reason to separate them. It will be seen, however, that from our specimens, the relation of the species is truly to the *Cordaites*, and that the genus cannot be separated from this order.

DICRANOPHYLLUM DIMORPHUM, sp. nov.

Pl. LIV, fig. 1–2.

Stems or branches small, the largest seen not quite two centimeters wide, when flattened; apparently articulated at the point of divergence of the branches and there abruptly narrowed, covered with a coaly bark about half a millimeter thick; stem leaves in oblique or right angle to the branches, narrow, three millimeters broad near the inflated smooth base at the point of attachment, linear or slightly diminishing toward the upper part, where they are forking once or twice, covered with a thick epidermis wherein the veins are buried and obtuse; nerves distinct under the epidermis, four or five primary ones near the base. unequally distant, intermediate ones indistinct or not perceivable with the glass. The stem, fig. 2, is marked upon the bark by round, small, inflated bolsters, corresponding under it to small cavities of the same form and size, very irregular in their distribution, sometimes three placed directly in line, sometimes scattered. I do not consider them as scars of leaves; they are probably the remains of small mollusks like those which so profusely inhabit the substance of the leaves of *Cordaites*. The top of the same fig. 2 which is not figured, bears a reniform scar like those of *Cordaites costatus*, but it is probably that from a top leaf like those of fig. 1.

The stem, fig. 1, seems like articulate by a depression across its whole diameter at the point of attachment of the branch 1*a*. The top of this branch terminates abruptly in an obtuse point, to which is attached a somewhat thick leaf of *Cordaites* character, or with parallel nervation. The top of the main stem bears a tuft of three leaves of the same character as that of *a*, flat, linear, one centimeter broad. The two on the left side are somewhat thick and the nervation immersed in the epidermis; that on the right side in *b* is decorticated or represented by the impression of its lower surface, with primary nerves distinct to the eye, three in one millimeter, with two or three distinct intermediate ones. The other leaves attached along the stem are those of *Dicranophyllum*, with nervation more or less obsolete by the thick epidermis, and are of the same character as those of fig. 2. We have here, therefore, in the abrupt termination of the branch *a*, and the large leaves at the top of the main branch, the evident characters of *Cordaites*, while the stem leaves are as evidently of *Dicranophyllum*. One of our specimens, fig. 3, represents a small fruit, oval and similar in form to the bulbilles, which Grand'Eury has seen in the axils of the leaves of *Dicranophyllum*, Pl. XXX, fig. 3, of his flora, but somewhat larger, with flattened borders, and of a thick texture; at least its surface is covered by a pellicle of coal as thick as that upon leaves of *Dicranophyllum*. From under it, or as in its axil, comes a *Dicranophyllum* leaf four millimeters broad, soon splitting twice, and separating in three narrow branches, hamulose in their curve, and dividing again in filiform laciniæ at their extremities. The character of nervation, four primary distinct nerves in one of the laciniæ, as seen in *a*, where the thick epidermis is destroyed, are exactly the same as in the leaves of fig. 2. Hence I believe that we have here positive evidence of the relation of these organs to the genus established as *Dicranophyllum* by the celebrated French author and of that of this genus to the order or family of the *Cordaites*.

[TÆNIOPHYLLEÆ.] TÆNIOPHYLLUM, Lesqx.

Stems large, leaves crowded, flat, thick, exactly linear, decurring at the base, surface smooth, opaque or shining.

The plants referred to this division resemble those of the narrow-leaved *Cordaites* by the size of their leaves only. These are still narrower, more exactly linear, and their surface is not striate or marked by nerves, neither when corticated nor when deprived of their coaly epidermis. Seen with a strong glass, their surface appears lined lengthwise and crosswise by a very thin areolation composed of appressed square meshes resembling those of the finest tissue. The leaves are, as far as can be seen, very long. I have not been able to find one in its entire length in any of the specimens examined. Their point of attachment still more than their smooth surface separates them from *Cordaites*, this point being marked by a linear narrow scar, rounded and slightly inflated at its lower end, generally pointed or acuminate upwards. The species referred to this group represents evidently a different generic division if not a separate family.

TÆNIOPHYLLUM DEFLEXUM, sp. nov.

Pl. LIV, fig. 4.

Stem or branch narrow, leaves closely imbricated, apparently decurrent, their base being covered by fragments of broken leaves decurving to and expanding in right angle from the stem, surface smooth.

The part of a branch figured here is entirely covered with broken fragments of detached leaves and its surface is nowhere exposed. The leaves deflexed along the borders in right angle to the stem, seemingly from above the decurrent base, all flattened and parallel, their border generally contiguous, measure one centimeter in width and thirty-seven centimeters in length to the point where the specimen is broken. The coaly epidermis is on the surface very thin and fragmentary, or spread here and there like powder by decomposition; but the leaves taken altogether appear of a somewhat thick consistence. I have of this species only one specimen, a large piece of shale, of which a fragment only is figured. Seen with a very strong glass, the veins of the surface may be approximately counted at twenty in one millimeter space; the cross wrinkles are also of the same size.

From the flat position of the leaves, all parallel and in the same direction, they appear as expanded originally upon the surface of the water. The narrowness of the stem also compared with the numerous and long leaves seem to indicate a floating plant. The cross section of the leaves show both surfaces separated by a thin layer of shale or clay, as if the leaves had been in their original state, somewhat inflated or tubulose.

Habitat. Cannelton. Mr. I. F. Mansfield.

TÆNIOPHYLLUM DECURRENS, sp. nov.

Pl. LI, fig. 4. *Pl. LII, fig.* 1.

Stem large; leaves decurring, narrower than in the former species, obtuse, sublinear or very slightly enlarged from the base upwards, long and thick; surface same as the former, more opaque.

Both the figures represent the leaves decurring upon the stem by an elongated base, but in Pl. LI, the leaves preserve in their length, as far at least as it can be seen, the same diameter all along their decurring base, while Pl. LII, they are gradually narrowed downward from their point of attachment, forming, as appressed upon another or against each other, narrow basilar prominent ridges. The leaves also of fig. LI, are slightly broader and more distinctly enlarged upwards. As the trunk of this specimen is not decorticated, I could not compare the point of attachment; and the characters of texture, facies and size of the leaves being the same, I consider them a variable form of a same species, perhaps even the variation is caused by a difference of compression and maceration of fragments of a same tree. The leaves average five to seven millimeters in width, crowded, forming by their imbricating and decurring long base a thick coating of coaly bark, which, when destroyed, leaves the surface smooth or irregularly lined and wrinkled, marked by numerous leaf scars, some of them distinctly seen, some others destroyed or obscure, so that their relative position is not definitively recognizable. They are placed in spiral, but their place is not always indicated by the scars. These scars generally obtuse and inflated at the base, where they measure one millimeter in diameter only, are gradually effaced and narrowed upwards, and therefore their character is far different from that of the *Cordaites* scars of leaves. The bark of the stem also is much thicker, not merely a thin smooth pellicle of coal, but a coating of shaly carbonaceous matter one millimeter thick or more. The divergence of the leaves from the stem is at a far less degree than in the former species; the thickness of the leaves and their surface tissue are the same.

Same *Habitat* as the former. Mr. I. F. Mansfield.

TÆNIOPHYLLUM CONTEXTUM, sp. nov.

Pl. LIII, fig. 2, *2a.*

Leaves narrow, linear, two millimeters broad, apparently very long, obtuse, twisted or interlaced together in tufts, and erect, diverging and curved in the upper part, surface opaque.

The tissue of the epidermis is of the same character as in the former species, from which this one differs merely by the narrower leaves more compactly bound together in the lower part. They appear to have been originally fistulose and flattened by compression. Their substance is thick, the epidermis a coaly layer irregularly disrupted in minute elongated granules, as marked in fig. 2a. I have not seen any of these leaves in connection with a stem. Though I do not consider this species as the same as the former, the characters are very similar. By compression and flattening an inflated border is here and there formed along some of the leaves, and by their superposition, it gives to the upper ones the appearance of a middle nerve. In a few cases when the heavy coating of coaly matter is removed, the veins appear in fasciles similar to those of the leaves of *Dicranophyllum*. These leaves are of the same kind as those mentioned on p. , a bundle of which seems connected to an *Artisia* in the description of *Cordaites* specimens.

Habitat. Same as the former. Mr. I. F. Mansfield.

DESMIOPHYLLUM, Lesqx.

Leaves narrow, sublinear, gradually enlarged from the base, where they are joined three or four together and coming out from a common point of the stem. Surface irregularly ribbed lengthwise by prominent large bundles of nerves, buried under the epidermis, which is thick, irregularly granulose, by splitting of the coaly surface as in the species of *Tæniophylium.*

From this coincidence of characters in the surface of the leaves, I was inclined to consider this peculiar branch as referable to the same genus. It, however, greatly differs by the agglomeration at their base of some of the leaves coming out in bundles from a common point of the stems, which appears irregularly articulate. Some of these leaves seem separate and joined single by a semi-lunar base to the stem. But I have to remark that the points of attachment of the inferior leaves in *a* are not perfectly distinct, and appear rather truncate than semi-lunar and embracing. The point of attachment of the leaves in bundles is, however, distinct. Therefore I am in doubt if the lower leaves may not have been separated from a common point and scattered along the stem, where by compression they have merely the appearance of being joined to it. The round points showing scars of bundles of leaves, are seen all along the stem and at equal distance from each other, even to the very base, and, therefore, the separate distribution of the others along the stem seems anomalous.

If the position of those scattered leaves and the point of attachment is right, as it can be seen upon the stone and as figured, this genus would partake of some of the characters of the leaves of *Cordaites*, by their semi-embracing base and the nervation buried into the substance of the leaves but recognized by the striæ of the surface. The degree of relation to the former genus is marked as seen above by the character of the epidermis. The connection of a number of leaves from one and the same point and from an apparent articulation is peculiar and gives to the branch an appearance comparable to that of the rhizomas of some *Equisetaceæ*; the characters of the leaves are, however, totally different from those of rootlets.

DESMIOPHYLLUM GRACILE, sp. nov.

Pl. LIII, fig. 1.

The specific characters are the same as those of the genus.

The figure is an exact representation of the specimen as far as it can be observed. The stem, a little more than one centimeter thick and flattened, seems to have been, if not fistulose, at least, soft and flexible. Its surface has the same appearance as that of the leaves, the epidermis having the same texture, and the bundles of nerves being also indistinctly discernible by the irregular ridges, or vertical, more or less obscure, and always obtuse wrinkles. The leaves appear long; none of them are preserved entire. They are sessile, two or three millimeters broad, only at their point of attachment, two to four together, to a circular scar, and gradually and equally enlarging upwards to about one centimeter at the point where they are broken. To the naked eye the leaves and stems appear smooth, rather shining, but with the glass the surface is seen minutely rugulose.

I do not know of any plant of the coal measures to which this fossil organism could be compared. The disposition of all the leaves of *Cordaites* is in spiral order, this species, therefore, can not be placed in the same division.

Habitat. Same as the former. Mr. I. F. Mansfield.

LEPIDOXYLON, Lesqx.

Stems, or branches of large size. The fragment figured is six centimeters broad, rapidly diminishing in its upper part to a conical point;

bark thin, covered with leafy scales; leaves of various size, sub-linear, narrowed or enlarged to the point of attachment, forking or dividing upwards in two or more laciniæ; nervation distinct with the glass only; primary nerves parallel, about three in two millimeters, buried in the epidermis, more distinct upon the decorticated face, generally inflated or half round, intermediate veinlets very thin.

LEPIDOXYLON ANOMALUM, Lesqx.

Pl. LIV, fig. 5. *Pl. LV, fig.* 1–1*a*.

Schizopteris anomala, Brgt. Veget. Foss. p. 334, Pl. CXXXV.

The character of the species is that of the genus.

The bark is a thin coating of coaly matter covered with sparse, distinct, foliaceous, oblong, lanceolate-pointed or acuminate scales, marked near the base by a short inflation like a midrib.

The lower surface of the stem where this thin bark is destroyed, shows round scars of various sizes from one to two millimeters in diameter, which represent either the base of the scale or that of small leaves. Short, small leaves narrowed to the base are attached upon the stem mixed with the scales. On the borders, the leaves are more enlarged at the base, some of them, however, narrowed; others seemingly broken and compressed upon the stem; others still, enlarged as a mere diverging part of the stem. They vary in diameter from three to ten millimeters, dividing by an anomalous forking with an acute sinus, either from near the base or from above, marked in the length by parallel, equal and equally distant primary nerves, and very thin intermediate veins.

I consider the species as identical with that of Brongniart, described in great detail, loc. cit., especially from the figures of Geinitz, Versteinerungen der Steinkohlen Formation in Sachsen, Pl. XXVI, fig. 2, which shows the divisions of the leaves of this species somewhat broader than those of Brongniart. In our specimens, as figured, the leaves are still broader. I must say, however, that in another specimen in my possession, which is like the top of Pl. LV, the stem, whose scars of scales are marked upon the bark in elevated round points, bears, mixed with these scales, linear leaves as narrow as those figured by Brongniart. Though there might be some doubt of this identity of species between the American and the European plants, they evidently belong to the same group, and are referable to the same genus.

Specimens of *Schizopteris* are very rare. After Brongniart none have been found, or at least described, but that of Geinitz. Brongniart in considering his species admits it as probably referable to Ferns. Geinitz joins it to *Aphlebia*, Presl., *Rocophyllum*, Schp., a genus which as seen from the species described in this flora, is a compound of mixed types, whose affinity is unascertained, and which Schimper considers as representing primary fronds of ferns. From this genus this species is positively removed, not only by its peculiar stem, but by character of its ribbon equally nerved leaves. On the true relation of the plant to any of the present time, I can say nothing. Like *Cordaites* it has some analogy to the *Cycadæ*, the Conifers and the Monocotyledonous, the Glumaceæ. But it is evident from the character of its leaves, some of which are narrowed to the point of attachment, that this species is in relation to the groups of the *Tænophyllum*, as also by its nervation to the *Cordaites*.

There is in the stem a peculiar character, which should be remarked. It rather appears to have been soft than of hard texture. The bark is so thin that by erosion some of the scales and young leaves are left attached to the lower surface of the stem as seen in the upper part of Pl. LV, fig. 1. On another side large leaves, especially seen upon my specimens, are decurring at the base along the stem, and seen to join it by a division of its borders, or come to it in a more or less open angle of divergence without any diminution of their width, and without apparent division in their point of union, just as if they were part of the stem. The epidermis of the leaves is also thin, its surface reflects the largest nervation buried in the texture, which then appears obtuse, distant as in figure 2 of Brongniart, but under the epidermis, these primary veins are less discernible, sometimes totally unobservable, the intermediate very thin vinelets covering the whole surface.

Habitat. These remarkable specimens, which if they do not throw light upon the relation of this plant to those of our time, give at least indication of their reference to the family of the *Cordaites*, have been found and communicated by Dr. J. H. Britts, from the Clinton coal of Missouri.

The Columella and Stapes in some North American Turtles.

By Sarah P. Monks.

(*Read before the American Philosophical Society March* 1, 1878.)

The columella is a small bone found in most reptiles which extends from the parietal to the pterygoid, and helps to complete the lateral wall of the cranium.[*]

In *Lacertilia* it is a distinct, slender rod "in close contact with the other cranial bones at its extremities only.

In *Testudinata* on the other hand it is broad, short and scale-like, and closely articulated with other bones.[†]

It varies considerably in the different species and families, and in some seems to be wanting.

In nearly all turtles there is a strongly marked ridge extending forward from the quadrate to the top of the skull, and another not so distinct from the pterygoid backward to the same point on the top of the skull.

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[*] See Professor Cope "On the Homologies of some of the Cranial Bones of the Reptilia, and on the Systematic Arrangement of the Class."

[†] Proceedings of Association for the Advancement of Science, 1870, Vol. XIX, pp. 223, 224, and Professor Huxley's Anatomy of Vertebrate Animals, 1872, p. 189.

The columella forms part of these ridges and occupies a space between them.

Its primitive shape, as indicated by young specimens, and nearly adult sea forms, is an open triangle, or, perhaps, two rods of bone touching at one end, but wide apart at the base. (From young *T. carolina.*)

In some species the triangular form is lost, and in most it becomes very much flattened in adult age.

It articulates above with the parietal, below with the pterygoids, in front with the parietal and sometimes the jugal, behind with the parietal and quadrate, and often forms part of the anterior margin of the foramen ovale.

From the quadrate there extends a small osseous style to meet it, and in most cases there is a groove in the pterygoids anteriorly for its cartilaginous extension to reach the jugal.

The descending plate of the parietal generally articulates directly with the pterygoid in front, but the columella is between them at other points.*

The columella in *Chelonia mydas* is triangular, with the front portion scale-like, but the back a flattened rod where it joins the quadrate.

In young specimens it is small and slender, and is placed on the base of the parietal near the centre, in a deep groove. It does not touch the jugal nor extend to the foramen ovale in the young.

In *Aspidonictes spinifer* it is thin, flat and scale-like, and either a continuation of it or a separate bone, extends forward, and is interposed between the parietal and pterygoid. It forms the margin of the foramen ovale, which, like all openings in the Trionyx skull is very large.

Aromochelys odoratus makes a second exception to the general rule in specimens I have examined of the parietal reaching the pterygoids in front.

In this case and in *A. spinifer* there are two bones to complete the lateral wall. Instead of curving upward, as in other species, they curve downward, and the anterior portion, or bone, if it proves to be separate, is firmly attached to the palate bone in adults. In one specimen this front part forms a complete column, whose hinder margin blends with the flat bone.

The columella is flat even where it joins the quadrate and bounds the greater part of the front of the foramen ovale.

In *Chelydra serpentina* it forms a flattened, concave triangle, and is joined to the quadrate, and often the jugal by two flattened rods. It is large, well marked, and bounds the foramen ovale.

In *Malacoclemmys palustris* it is a narrow band, deeply concave, extending from the inward process of the jugal to the quadrate, and forms part of the ridge in front of the foramen ovale.

In *Pseudemys scabra* and *Ps. concinna*, it is much as in *M. palustris*, but in *Chrysemys picta*, *Chelopus guttatus*, *Chelopus muhlenbergii*, and *insculptus*, and *Cistudo clausa* it is much smaller, and does not extend to the jugal. In all these emydes the posterior descending portion of the parietal forms the most of the ridge in front of the foramen ovale.

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*See Fig. 9. Ch. serpentina of Professor Cope's articles on "Homologies of Cranial Bones of Reptilia."

In *Testudo carolina* it is scale-like with the posterior a flattened rod, and the anterior portion far from the jugal.

There is nothing peculiar in the adult, but in the young the columella is small and slender, and in position and shape resembles that of a half-grown *Chelonia mydas*.

The stapes (sometimes called columella auris) in most birds, reptiles and amphibians, is a very slender rod with a disc at one end. The disc end is attached to the fenestra ovalis, while the external end is attached to the tympanic membrane.* The bone inclines forward at a decided angle. To reach the membrane it passes through a canal, or foramen, made by the folding in of the posterior part of the quadrate bone. The folding in is more complete in adult specimens, and the foramen near the front of the tympanic cavity.

In *Chelonia mydas* the canal is unusually open, and the stapes on one side only protected by muscles.

In *A. spinifer*, *Ch. serpentina* and *Macrochelys lacertina*, the stapes is completely surrounded by bone, the edges of the quadrate being sutured together, so as to form a foramen.

The edges touch in *H. odoratus*, but do not form a suture.

In *M. palustris* the space is open, but the edges of the quadrate approach quite near each other. This is a common form in the emydes. The exceptions are *Ch. insculptus*, where there is a suture, and *Chrysemys picta* and *Chelopus guttata* where the edges lap.

The suture is strongly marked in *T. carolina*.

Notice of the Discovery of the position of the Crural Processes in the Genus Atrypa.

BY WILLIAM GINLEY.

(*Read before the American Philosophical Society March* 1, 1878.)

It is already well known that, in 1867, Professor R. P. Whitfield, palæontologist of Albany, New York, announced the discovery of "a loop connecting the spiral cones" in the genus *Atrypa*.

In the Twentieth Regent's Report he describes in detail this loop with its position and affinities; accompanying his article is a plate showing various examples from different localities representing a wide geological distribution.

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* Cuvier Ossemens Fossiles IX, p. 355.

From his article I will quote only those parts expressive of his investigations and views upon the crural processes or loop :

"By carefully cutting and preparing favorable specimens, I have found that in place of the short crural processes so often figured, there is an entire and continuous loop connecting the spiral cones."

"From its origin in the posterior portion of the first volutions of the spires, the loop curves gently forward and upward ; the central or elevated portion lying between and behind the cones, and forming a more or less abrupt curve or prolonged into a point directed toward the dorsal valve."

In palæontological studies, it is of rare occurrence that the student obtains a specimen of the *Brachiopoda* in which the internal appendages are not coated with silica, calcite, or some other mineral, and not unfrequently it happens that we notice two or more parts connected by a deposit of this kind.

After having examined Professor Whitefield's Plate, and also many specimens from the localities cited by him, I am inclined to believe that his examples were, to a slight extent, coated as above described. In October 1877, I obtained, from the Devonian of Clarke County, Indiana, specimens of *Atrypa** whose internal appendages were replaced by silica, and appeared to be free from the usual coating.

It is hardly necessary to remark that these appendages are very fragile, and would hardly admit of the slightest touch, yet by careful cutting I was able to expose the posterior portion of the visceral cavity so as to permit of a close examination of the "loop connecting the spiral cones." Several specimens were examined, each one of which shows the "loop" to be composed of *two* long crural processes arising from the bifurcating of the posterior portion of the first volution of the cones. Following the convexity of the cones, they gently curve forward and upward, attaining a height of about one-third that of the cones. The extremities are separated by a space of about one sixty-fourth of an inch.

The crural processes gradually twist until the lower surfaces present themselves successively to the anterior and top, abruptly expanding and curving posteriorly, the extremities pointing downward, the ends opposing each other with a rounded, semi-circular edge, the convexity being upward, the lower anterior edge being slightly developed beyond the upper edge so that, upon looking from above, the space between the edges appears much wider in the middle. The specimens examined show the crural characters to be constant, and as above described.

When we consider the slight space existing between the crural extremities, and the frequency of their being coated, it is not to be wondered at that they should appear to be "joined and continuous."

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* A variety of *A. reticularis L.*

On the Aerolitic Epoch of November 12*th*–13*th*.

BY DANIEL KIRKWOOD.

(*Read before the American Philosophical Society, March* 1, 1878).

It is now well-known that clusters of small meteors—the so-called shooting stars—move in elliptic orbits about the sun. Catalogues of fire-balls and meteoric stones indicate, moreover, that groups of *larger bodies*, somewhat widely dispersed, revolve in like manner about the centre of our system; their orbits in certain cases intersecting that of the earth. The 12th and 13th of November is one of these *aerolitic epochs;* the date being nearly coincident with that of the great November shower of falling stars. The writer until recently supposed the meteorites of this epoch to revolve in the same orbit with the nebulous swarm which furnished the showers of 1833, 1866 and 1867.* Later study of the facts, however, has rendered the theory of this intimate relation extremely improbable. The principal phenomena of this epoch (not including star showers) are the following:

(*a.*) 1582, meteoric phenomena at Zurich.
(*b.*) 1765, an extraordinary meteor at Frankfort.
(*c.*) 1820, a detonating meteor seen in Russia.
(*d.*) 1822, fall of aerolites at Potsdam and Leipsig.
(*e.*) 1828, a great meteor seen in full sunshine in France.
(*f.*) 1835, a fall of aerolites in France.
(*g.*) 1849, a fall of aerolites at Tripoli.
(*h.*) 1849, a large meteor seen in Mecklenberg.
(*i.*) 1856, a meteoric stone fell in Italy.
(*j.*) 1877, a brilliant meteor seen in Arkansas and another in Wisconsin.

REMARKS.

(*a.*) This so-called "fall of fire from heaven" occurred on the 28th of October, O. S., or November 7th, N. S. Making allowance for the precession of the equinoxes, the date corresponds at present to the morning of November 12th.

(*b.*) This bolide was observed November 11th, and is the only one in our list which occurred *very* near the epoch of the great star shower in November.

(*c.*) See Greg's catalogue of fire-balls and meteoric stones; also Quetelet's catalogue of shooting stars.

(*d.*) Several aerolites fell at this date near Potsdam, and also at Taucha, near Leipsig, about 75 miles distant.

(*e.*) See Quetelet's catalogue.

(*f.*) This fall of aerolites occurred on the evening of November 13th, in the department de l'Ain, France. The meteor was *unconformable* to the radiant of the Leonids; its motion being from south-west to north-east. A fragment is in the collection of Prof. Shepard, of Amherst, Massachusetts.

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* A list of stone-falls, detonating meteors and large fire-balls which have appeared about this epoch is given in Meteoric Astronomy, pp. 58–60.

(*g*.) The meteoric phenomena of this date are thus described in the catalogue of Mr. Greg: "Seen in the southern sky. Varied in color; a bright cloud visible one and a half hours after; according to some a detonation heard fifteen minutes after bursting. Seen also like a stream of fire between Tunis and Tripoli, where a shower of stones fell; some of them in the town of Tripoli itself."

(*h*.) This fire-ball appeared on the same evening or night.—Greg's catalogue.

(*i*.) This aerolite fell at Trezano. A fragment is in the collection of Professor Shepard.

(*j*.) A large meteor was seen by Professor Robert C. Hindley, of Racine, Wisconsin, on Sunday evening, November 11th, at three minutes past six o'clock (Chicago time?). This meteor is thus described by Professor H. in the *Scientific American* for December 1, 1877: "Direction N. N. E.; altitude at commencement of course about 30°; length of course from 10° to 12°; time of falling about 8 seconds. It fell towards the west, making an angle in falling to the earth of about 65° with the vertical passing through the body. During the latter three-fourths of its course, its length, including the luminous trail, was about one-half of a degree. The nucleus was very brilliant; its color at first a yellowish-white, then a light green, and lastly, a greenish-yellow. Could its color have been due to boron, thallium, &c.? I find no record in any of the numerous analyses of meteoric stones of the presence of elements likely to give the green color."

On the following evening, November 12th, at 6h. 36m. (Memphis time), Frank L. James, Ph. D., M. D., of Osceola, Arkansas, saw another meteor in the same part of the heavens, and in some respects so strikingly resembling that observed in Wisconsin, that he was disposed, on reading Prof. Hindley's description, to think they had observed the same phenomenon, and that one or the other had mistaken the date. I have, however, corresponded with both the gentlemen, and have found that the meteors were seen on different evenings. "The date is fixed," says Dr. James," not only by my own 'case-record' but by that of a friend and brother physician who assisted me in an amputation on the previous day." The following account of the Arkansas meteor is extracted from Dr. J's communication in the *Scientific American* for December 29th, 1877: "I was startled by a sudden glare of light which seemed to come from right in front of me. Throwing up my eyes I saw a large and very brilliant meteor in the north-east, falling apparently nearly straight downward, with a slight deviation to the east. When I first saw the meteor it was about 30° in height, and judging from the length of time it took to travel the remainder of its course, it must already have fallen 3° or 4°. It fell through an arc of about 12° or 15° in all, and was about ten seconds in falling. When I first saw it it had a golden hue which suddenly changed to green, of that peculiar shade produced by burning chlorate of potash with nitrate of barium and sulphur. The light shed by it was pulsating and sufficiently powerful to light up the Tennessee shore and the sand bars, so as to show every log and stump."

PROBABLE INFERENCES.

1. The number of stone-falls and detonating meteors observed on the 11th, 12th, and 13th of November is more than double the average daily fall. Hence the periodic return of a cluster whose orbit intersects that of the earth is rendered highly probable.

2. None of the aerolites or meteors of the preceding list are known to have been conformable to the radiant in Leo, while those of November 13th, 1835 and November 12th, 1877, were certainly *un*-conformable; their heliocentric motion having been direct. This aerolitic group cannot therefore be connected with the shooting stars of November 14th.

3. These facts, it must be confessed, are unfavorable to the hypothesis, formerly advocated by the writer, that "meteoric stones are but the largest masses in the nebulous rings from which showers of shooting stars are derived."* It is true that in the great star showers of 1799, 1833 and 1866 a number of large fire-balls were seen which belonged undoubtedly to the cluster of Leonids; but it is remarkable that among all this number no detonation was ever heard, and that no meteoric stones have ever fallen during these extraordinary star showers.

4. The dates of the phenomena given above indicate a period of seven years. Several sporadic fire-balls, however, have appeared at this epoch, and no definite conclusion in regard to the period is possible without additional data.

Criteria of the Nebular Hypothesis.

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(*Read before the American Philosophical Society, March* 1, 1878.)

The views of astronomers, respecting the mode of action in world-building, have been various and vague. No one appears to have put upon record any numerical calculations, undertaken with a view crucially to test the nebular hypothesis, or any suggestions as to the proper way to make such calculations.

Statements have been made, at different times, by investigators who thought that observed velocities might be explained by the results of nebular condensation, but no one, except Ennis,† has given us any means of judging on what grounds the belief rested. It seems probable that they all regarded the formation of planetary rings as confined to the superficial nebular layers; that their studies were limited to the direct action of living forces; that they used no adequate criteria for distinguishing between nebular and meteoric influences; and that their methods often, if not always, virtually assumed the very principles which they sought to prove.

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* Meteoric Astronomy, p. 64.

† "Origin of the Stars;" L., E. & D. Phil. Mag. April, 1877.

Herschel,* somewhat obscurely, intimated the possibility that nuclei might be simultaneously formed, at different points within the body of the nebula, by the action of particles of different densities. Peirce, Alexander, Hill, Wright, Kirkwood, and myself, discovered various planetary harmonies which point, unmistakably, to such synchronous internal and external activities. Yet no one seems to have thought of the likelihood that interior portions could acquire a greater angular velocity than the nebular surface, so that a planet might revolve in less time than its Sun rotated, or a satellite in less time than its primary, until I called attention to the fact that the time of nucleal rotation must vary as the $\frac{4}{3}$ power of the time of superficial nebular revolution.

The significance of this relation does not seem, even now, to be generally understood. For, when Professor Hall found that the inner satellite of Mars actually revolved with such unprecedented rapidity, Kirkwood asked, in the *American Journal of Science and Art*, "How is this remarkable fact to be reconciled with the cosmogony of Laplace?" The same question has been asked by others, and variously answered. It may, therefore, be a fitting time to state, more explicitly, some obvious evidences of present nebular activity, such as are shown in the following comparative synopsis:

$M \div$	n	n^2	$n^3 = ♂_2 = 3♀_2$
π	$\pi n = 2\Psi_3$	$\pi n^2 = ♃_3 = 2\textcircled{101}$	
π^2	$\pi^2 n = ♅_3 = 2♄_3$	$\pi^2 n^2 = ♂_4$	
π^4	$\pi^4 n = 2⊕_2$	$\pi^4 n^2 = ⊙\rho_0$	
$\pi^7 = ♀_1 = 2☿_3$			

M = modulus of light at Sun's surface = 2204.95 × Earth's mean radius-vector, a quantity of which I have already shown the importance; (1) by identifying the velocity of light with the limiting velocity toward which the mean solar centrifugal and centripetal forces both tend; (2) by showing that the same harmonic progression is manifested in the Fraunhofer lines and in planetary distances; (3) by tracing numerous harmonic arrangements among spectral lines of chemical elements. M is the common dividend; the combinations of various powers of π and n are divisors.

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* Outlines of Astronomy, §§ 871-2.

π = ratio of circumference to diameter, and, as I have also shown, ratio between incipient and complete centrifugal dissociative force.

n = Gummere's criterion $= 11.6569 = \frac{2}{3-2\sqrt{2}}$.* I give it this designation, because I obtained it from a calculation which was suggested by a criticism of Samuel J. Gummere, late President of Haverford College, on Ennis's theory. The criticism, together with Ennis's rejoinder, may be found in Appendix II, to "Origin of the Stars." Gummere says, of the relation $1 : \sqrt{2}$; "This relation being essential to stability, must exist, whatever be the origin of the velocity. Hence it proves nothing as to the source of the orbital velocity, except that it is entirely *compatible* with the assumption that it is due to *gravity*." This cautiousness of statement is like that which has enabled Herschel's presentation of the nebular hypothesis to adapt itself to all the astronomical discoveries which have hitherto been made.

ρ_0 = Sun's present nebular radius, or the distance at which planetary revolution and solar rotation would be synchronous.

The subscript figures denote apsidal positions: 1, secular perihelion; 2, mean perihelion; 3, mean; 4, mean aphelion; 5, secular aphelion.

The multiple, 2, denotes the primitive nebular radius which would give the *vis viva* of circular-orbital revolution, by simple condensation to the present planetary radius-vector.

It should be noted that critical positions of all the planets, together with some asteroidal positions, are represented in the table; that all the symmetrical combinations of π and n, which are embraced in the table, have planetary representatives; that both rupturing factors seem to have been simultaneously operative; that, after the first conversion of linear into circular motion, the exponential increments of π are figurate; and that the relations have all been found, not by happy guessing, but by following indications which are mathematically deducible from the necessary action of central forces.

The following table shows the character of the accordances:

	Theoretical.	Observed.		Minimum Error.	Maximum Error.
$M \div \pi n$	60.210	$2♆_3$	60.068	+ .142	+ .142
$M \div \pi^2 n$	19.165	$♅_3$	19.184	— .019	— .019
		$2♄_3$	19.078	+ .087	+ .087
$M \div \pi n^2$	5.165	$♃_3$	5.203	— .038	— .038
		2 (101)	5.168	— .003	— .003
$M \div \pi^2 n^2$	1.644	$♂_4$	1.644	.000	+ .120
$M \div \pi^4 n$	1.942	$2⊕_2$	1.932	+ .010	— .058
$M \div n^3$	1.392	$♂_2$	1.403	— .011	— 132
		$2♀_2$	1.396	— .004	— .054
$M \div \pi^7$	.730	$♀_3$	.723	+ .007	+ .007
		$2☿_3$	.774	— .044	— .014
$M \div \pi^4 n^2$	.167	$⊙\rho$	.167	.000	.000

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*See *ante*, p. 99.

Gummere's criterion gives the following results of internal rupture, starting from the theoretical origin of Neptune's present orbital *vis viva*. In each instance, the theoretical angular velocity of revolution, for the dense inner planet, must have been $(11.6569)^{\frac{3}{2}}$ times as great as the angular velocity of the undisturbed portions of the gasiform rotating nebula:

	Theoretical.	Observed.
$2\Psi_4 \div n$	5.204	$♃_3$ 5.203
$\Psi_3 \div n$	2.576	⑼③ 2.577
$♅_4 \div n$	1.760	$♂_5$ 1.736
$♅_3 \div n$	1.646	$♂_4$ 1.644
$2♄_3 \div n$	1.637	
$2♃_4 \div n$	.931	$\oplus_1$ .932
$♄_2 \div n$	.779	$♀_5$ .774
$♄_1 \div n$	.749	$♀_4$ .749
$♃_5 \div n$	.473	$☿_5$ .477
$♃_3 \div n$	.446	$☿_4$ .455

The great density of Jupiter, as compared with Neptune; the great density of the intra-asteroidal, as compared with the extra-asteroidal planets; the position of Earth, in the centre of the belt of greatest planetary condensation; the connection (n) between the positions of Jupiter's incipient and Earth's complete condensation; the fact that Jupiter is the largest extra-asteroidal, while Earth is the largest intra-asteroidal planet; the further evidence of an intimate connection between Jupiter and Earth, which is furnished by the equivalence of their dissociative velocities; the probability, so far as we can judge from Sun's present nebular radius (ρ_0), that all the planets were formed when their orbital revolution was accomplished in less time than the rotation of the solar nucleus; all point to the increments of wave velocity and of centripetal velocity as a source of interior nebular rupture, giving a new meaning to Herschel's doctrine of "subsidence," and making the inner moon of Mars a confirmation, rather than a formidable objection, to the nebular hypothesis.

The tendency to synchronous oscillations under the action of central forces, which LaPlace, Peirce, and Kirkwood have so happily adduced in explanation of some of their planetary harmonies, is shown (1) in the synchronism of solar rotation with the time of passage of a light-wave through the major-axis of the Modulus-atmosphere; (2) in the synchronism of planetary revolution at Sun with the time of passage of a light-wave through the major-axis of the Uranus-Earth ellipse; Earth being the centre of the belt of greatest condensation, and Uranus having a radius-vector which is a mean proportional between M and ρ_0, as well as between $\frac{M}{n}$ and $2 \oplus_2$.

For readers who are inclined to test numerical coincidences by the calculus of probabilities, I have marked the errors, in the general table, both by their deviations from the nearest apsis and by the deviations from the semi-axis major. The importance of my introduction of various apsides into the study of planetary harmonies, has been fully recognized by Alexander, the Nestor of harmonic astronomy; but in order to avoid all possible cavil, I assume the probability that each quotient of M by $\pi^{a}n^{\beta}$ is of the form $p \pm$ (r or less) $= \frac{2r+1}{p}$; r being the maximum tabular error, and the unit of comparison being .001 of Earth's semi-axis major. This gives a probability of more than $26(10)^{19}$ to 1 in favor of the assumed laws of planetary formation, a probability which is immeasurably increased by a consideration of the various phyllotactic, teleologic, oscillatory, elastic, centrifugal, and centripetal influences, which have been pointed out.

The three cardinal planetary centres, viz.: the centre of greatest annular condensation, ($\oplus$); the centre of planetary inertia, (♄); and the centre of incipient solar specialization, (Ψ); lend interest to the following table:

$r \div r_0$	$\rho \div \rho_0$	ρ	O.	E.
2^3	2^4	$2.667r_1$	$2.667 = \frac{8}{3}\oplus$	.000
			$2.637 = 2^{\frac{1}{2}}\oplus_1$	.011
			$2.614 = \Psi_5 \div n$	.020
			$2.780 = \text{♄}_1 \div \pi$	.043
3^3	3^4	$13.500r_1$	$13.490 = 2^{\frac{1}{2}}\ \text{♄}_3$	.001
4^3	4^4	$42.667r_1$	$42.474 = 2^{\frac{1}{2}}\ \Psi_3$	.005
$214.86 = r_1$	$214.86^{\frac{4}{3}}$	$46083.4r_0$	$46164.7 = 214.86^2$	.002
2049.51	$2049.51^{\frac{4}{3}}$	$932262r_0$	$947511 = 2M$	.016
6453.06	$6453.06^{\frac{4}{3}}$	$4302218r_0$	$4263801 = 9M = [\ast] \div n$	.009

This table represents theoretical stages of nebular condensation, based upon forces which are now operating within the solar system. $r_0 =$ present solar nucleal radius; $r =$ past nucleal radius; $r_1 =$ Earth's semi-axis major; $\rho_0 =$ present nebular radius; $\rho =$ past nebular radius; $O =$ observed positions; $E =$ ratio of error, found by dividing the difference between O and ρ, by ρ; $[\ast] =$ stellar distance, with parallax 0.″89, which is of the same order as the distance of *a Centauri*; the last three numbers in the left hand column represent, respectively, the semi-axes major of Earth, Saturn, and Neptune.

It is further worthy of note, that Earth's position is a mean proportional between the nebular radius when Sun's nucleus reached the Earth, and Sun's present surface; that the nebular radius of the Jupiter-nucleal Sun was nearly M, (.89 M); that the nebular radius of the Uranus-nucleal Sun was nearly 5 M, (4.996 M); and that M, when Sun was expanded to the outer portions of the asteroidal belt, was coincident with $[\ast]$, the origin of the incipient condensation of the nebular radius of the Neptune-nucleal Sun.

Section of Devonian rocks made in the Catskill Mountain at Palenville; Kauterskill Creek, New York, by MR. ANDREW SHERWOOD, *for* PROFESSOR JAMES HALL, IN 1874.

(*Read before the American Philosophical Society, March* 15, 1878.)

Feet.	ROUND TOP OF THE CATSKILL MOUNTAIN.
440	SS. coarse, *gray sandstone*. (Specimen No. 152.)
48	Concealed. (151.)
16	SS. coarse, gray. (150.)
130	Concealed. (149.)
32	SS. coarse, gray. (148.)
53	Concealed. (147.)
200	SS. coarse, gray, with many pebbles scattered through it. (146.)
27	Shaly rock, Red. (145.)
37	Concealed. (144.)
23	SS. coarse, gray ; scattered pebbles. (143.)
340	Concealed. (142.)
19	SS. coarse, gray. (141.)
20	Concealed. (140.)
50	Shaly rock, Red. (139.)
15	Concealed. (138.)
33	SS. coarse, gray. (137.)
14	Shaly rock, Red. (136.)
35	SS. coarse, gray. (135.)
2	Shaly rock, Red (134.)
5	SS. coarse, gray. (133.)
50	Concealed. (132.)
16	Conglomerate, coarse. (131.)
10	SS. reddish. (130.)
11	Shaly rock, Red. (129.)
63	SS. coarse, gray. (128.)
152	Conglomerate, coarse. (127.)
47	Shaly rock, Red. (126.)
88	SS. coarse, gray ; pebbles. (125.)
37	Shaly rock, Red. (124.)
38	SS. coarse, gray ; scattered pebbles. (123.)
480	Concealed. (122.)
29	SS. coarse, gray. (121.)
219	Concealed. (120.)
15	SS. coarse, dark gray. (119.)
22	Shaly rock, Red. (118.)
60	Concealed. (117.)
12	SS. coarse, dark gray. (116.)
140	Concealed. (115.)
40	SS. gray (Reddish towards the top). (114.)
103	SS. red and gray ; beds of Red shaly rock. (113.)
103	Shaly rock, Red. (112.)
8	SS. gray. FISH-BONE bed 1 ft. near the bottom of the 103 ft. (111.)
4	Shale greenish and dark blue. (some Fish-bones.) (110.)
20	SS. gray. (109.)
68	Shaly rock, Red. (108.)
½	FISH-BONE bed, 6 to 8 in. (107.)
1½	Shaly rock, Red, mottled with green. (106.)
¾	FISH-BONE bed, 6 to 12 in. (105.)
2	Shaly rock, greenish. (104.)
6	SS. bluish-gray. (103.)

7	Shaly rock, Red, somewhat mottled green. (102.)
6	Shaly rock, greenish. (101.)
9	SS. bluish-gray. (100.)
3	Shale, greenish-gray. (99.)
3	Shaly rock, nubbly, variegated, considerable per centage of peroxide of Iron. (98.)
47	SS. bluish-gray. (97.)
6	Shales, Red and green. (96.)
10	Shaly rock, gray and greenish. (95.)
6	Shaly rock, Red and green. (94.)
	SS. bluish and gray ; of great thickness at the village of Palenville.—Continued downwards in the following

Section along Schoharie Creek in Schoharie County, N. Y., between Gilboa and Middleburg, from the Catskill down to the Upper Helderberg, by Andrew and Clark Sharswood. Report to James Hall in the year 1873.

12	Red shaly rock. (This is supposed to be the same bed No. 94 which bottoms the Catskill Section of 1874.) Top of Manorkill Cataracts at Sawmill. (94.)
15	Bluish-gray SS. (93.)
10	Gray shaly rock. (92.)
14	Gray SS. (91)
2	Gray shale. (90.)
15	Gray shale SS. (89.)
12	Red shaly rock, with green bands. (88.)
17	Thick bedded gray SS. (87.)
20	Thin bedded gray SS. (86.)
9	Thin bedded gray SS., with *plants*. (85.)
20	Hard (false bedded some of it) gray SS. (84.)
54	Gray SS. (83.)
30	Unknown to foot of Cataracts. (82.)
25	Gray SS. (81.)
2	Dark sandy shale. (80.)
8	Gray SS. (at Gilboa) *stumps, leaves, stems*. (79.)
6	Dark shale. (78.)
10	Gray SS. (77.)
14	Gray and bluish shale and shaly rock. (76.)
4	Red and green mottled shale. (75.)
2	Redish hard SS. (74.)
40	Gray SS. (the top makes the Gilboa falls.) (73.)
40	Gray SS. (72.)
?	Unknown. (71.)
40	Hard gray SS. (with sharp S. W. dip.) (70.)
25	Unknown. (69.)
20	Gray SS. (68.)
50	Unknown. (67.)
10	Coarse flaky gray SS. (makes top of Little Manorkill fall.) (66.)
36	Unknown. (65.)
22	Gray SS. (64.)
27	Gray shaly rock, *fossils* in upper part. (63.)
17	Gray shaly SS.; top is Cong., *some fossils*. (621)
60	Unknown. (61.)
16	Gray flaky SS., *fossil plants*. (60.)
24	Gray slate and SS. (59.)
9	Gray SS. (58.)
10	Unknown. (57.)

4	Hard gray SS. (56.)
33	Gray and bluish shale, a *few fossils.* (55.)
8	Gray SS. (54.)
9	Dark shale. (53.)
34	Unknown. (52.)
?	Gray SS. (51.)
36	Unknown. (50.)
30	Gray, greenish shale, shaly rock, *few fossils.* (49.)
13	Gray SS. (48.)
15	Greenish shale. (47.)
14	Gray SS. (some false bedded.) (46.)
20	Gray SS. and shaly rock. (45.)
4	Greenish rubbly rock. (44.)
15	Gray SS., false bedded (makes Pitchen Hollow rapids). (43.)
14	Unknown. (42.)
35	Massive gray SS., marked horizon. (41.)
21	Dark shaly rock. (40.)
8	Thin bed gray SS. (39.)
20	Unknown. (38.)
28	Coarse gray SS. (37·)
34	Unknown. (36.)
8	Gray SS. (part Concretionary.) (35.)
42	Unknown. (34.)
36	Dark, and gray shaly rock. (*fossils*, spirals towards top.) (33.)
50	Unknown. (32.)
72	Gray SS., dark shale in the upper part of it (makes top of the Wanhalla), *some fossils*.. (31.)
23	Dark shaly rock. (30.)
87	Gray SS. (29.)
8	Dark shaly SS., *few fossils.* (28.)
8	Gray SS. (27.)
4	Dark shale. (26.)
6	Bluish-gray SS. (25.)
41	Gray and dark sandy shaly rock. (24.)
44	Unknown. (23.)
50	Thin bed gray SS.; a little of it false bedded; some Concretionary. (22.)
48	Gray sandy shaly rock. (21.)
27	Thin bed gray SS. (20.)
4	Gray concretionary rock. (19.)
183	Gray shaly SS. (base of Wanhalla Mtn.) (18.)
20	Bluish-gray SS. (17.)
70	Gray and dark bluish-black Shale. ("Tow-path" road.) (16.)
25	Bluish-black and gray shaly rock. (15.)
16	Unknown. (14.)
23	Dark gray and blackish shaly rock, *fossils lower part.* (13.)
29	Gray and dark blue shaly SS. (lower end of Tow-path road). *Probably part of bed at top of Vooman's nose.*) (12.)
49	Gray shaly SS.; top of Vooman's nose, passes under water at lower end of Tow-path road. [Inclination 581 feet in 2 miles, making no allowance for fall of Schoharie Creek.] (11.)
11	Blackish shale. (10.)
28	Gray shale and shaly SS. (9.)
284	Dark gray shale (Vooman's nose), *fossils* most abundant in upper part. (8.)
205	Unknown up to ledge on Vooman's nose. Surface covered with dark gray shale. 10 ft. of black shale is exposed by road cut half a mile west of Vooman's nose; and supposed to come in this interval of 205 feet. (7.)

100	Unknown in Middleburg Village. (6.)
2	Black shale. (5.)
21	(Black shale ?) judging by the surface. (4.)
2	Black slate. (3.)
15	Unknown. (2.)
	Helderburg Limestone. Half a mile below Middleburg, at grist mill. (Makes falls in the Schoharie.) (1.)

Section of the Palæzoic Rocks in Blair County, by Mr. Franklin Platt and Mr. R. H. Sanders, of the Second Geol. Surv. of Penna., in 1877.

(*Communicated to the American Philosophical Society, April* 19, 1878.)

The following section of the Palæzoic rocks, exposed in Blair County, was made by compiling the sections taken from the following points:

From the summit of the Allegheny Mountains at Bennington along the Pennsylvania Railroad to Altoona for XII, XI, X, IX, and VIII. At Frankstown for VII. At Hollidaysburg for VI. At McKee's Gap for V. At Tyrone and Spruce Creek Gaps for IV, III. From Spruce Creek to Tyrone Forges for II. The measurements are based on the railroad lines and from the topographical survey of Blair County.

From the Mahoning Sandstone to coal A is taken from report H H.

XII to VIII was measured by plotting on the railroad map the various cuts and measuring the rocks in each cut, and then projecting them over onto a section line. The projection of the various cuts onto the section line was most likely accompanied by a few errors but they would not make any material difference in the thickness.

The entire thickness of VII could not be measured at Frankstown, where the best exposure could be seen. A good measurement of VI was obtained at the "Chimney Rocks" at Hollidaysburg.

The measurement of V taken along the railroad cut at McKee's Gap gives a good measurement except the lower part which is concealed, and which should have the horizon of the "Frankstown" ore in it.

The Medina Sandstone shows best on the Pennsylvania Railroad, east of Spruce Beech Tunnel. The remainder of IV shows best in Tyrone Gap, but the rocks are crushed and the measurement is not reliable.

III a complete section of these slates do not show anywhere in the county.

II the thickness of these limestones and dolomites is taken from a carefully measured section along the Little Juniata from Spruce Creek to Tyrone Forges.

R. H. Sanders.

345′	4″	XIII	Lower Productive Coal Measures.
223′	1″	XII	Pottsville Conglomerate.
283′		XI	Mauch Chunk Red Shale.
1,274′	4″	X	Pocono Sandstone.
2,560′		IX	Catskill Sandstone and Shale.
6,519′	2″	VIII	Chemung, Portage, Hamilton, Upper Helderburg
50′		VII	Oriskany Sandstone.
900′		VI	Lower Helderburg Limestones.
1,328′	3 ′	V	Clinton Red Shale.
2,365′	10″	IV	Medina and Oneida Sandstone.
900′		III	Hudson-River and Utica Slates.
6,600′		II and I (?)	Trenton, Calciferous and perhaps Pottsdam
23,348′			Palæzoic rocks exposed in Blair County.

Mahoning Sandstone.
2′ 8″ Coal bed.
20′ Drab slates.
5′ Olive shales.
10′ Massive slates.
20′ Olive slates and shales.
5′ 6″ Coal bed E.
2′ Impure fire clay.
20′ Sandstone and black slate.
3′ Limestone.
{20′ Ferruginous slates and shales.
20′ Sandstone and sandy shales.
3′ Coal bed D¹.
1′ Fire-clay.
21′ Sandstone, drab.
20′ Black slate.
2′ 10″ Coal bed D.
11′ Drab slates holding ore balls.
0′ 7″ Sandstone.
13′ Blue slates.
15′ Sandstone, massive, drab.
12′ 6″ Slate.
6″ Coal }
6″ Slate } Bed C.
1′ 8″ Coal }
6′ Fire-clay.
12′ Sandstone.
1′ 3″ Slate.
0′ 4″ Coal.
7′ Sandstone.
8′ 10″ Black slate, with calamites.
3′ 6″ Coal bed B.
3′ Fire-clay.
29′ Shales.
2′ Black slate.
1′ 8″ Coal bed A¹.
23′ Slates.
4′ Sandstone, gray.
4′ Coal bed A.
9′ Fire-clay.
Total......345′ 4″
14′ SS., coarse grained iron stained.
0′ 1″ Coal.
9′ Fire-clay.
4′ Slaty sandstone.
15′ Fine grained grayish white SS.
81′ Massive white sandstone.
100′ Concealed.
Total, XII......223′ 1″
110′ Red shale.
40′ Gray slate.
5′ Red shale.
12′ Gray slate.
2′ Red slate.
4′ Fine grained sandstone.
6′ Red slate.
4′ Greenish gray slate.
6′ Red shale.
2′ Gray slate.
52′ White and grayish-white coarse grained sandstone.
10′ Gray slate.
5′ Red slate.
10′ Gray sandstone.
10′ Red shale.
Total XI......283′
2′ Gray shale.
200′ Gray sandstone.
3′ Red shale.
334′ Massive gray sandstone.
20′ Dark gray slates.
266′ Massive gray sandstone.
15′ Olive-gray sandstone.
20′ Red shale.
60′ Gray sandstone.
40′ Gray slate.
30′ Gray sandstone.
5′ Greenish-gray slate.
2′ Gray sandstone.
10′ Gray slate.
15′ Massive gray sandstone.
5′ Brown shale.
20′ Red shale and slate.
15′ Brown sandstone.
5′ Gray slate.
20′ Red shale and slate.
20′ Massive gray sandstone.
29′ Red shale.
11′ Gray sandstone.
10′ Gray slaty sandstone.
17′ Brown slaty sandstone.
10′ Red shale.
1′ Gray micaceous sandstone.
1′ Iron ore, greenish-gray.
0′ 1½″ Gray micaceous sandstone.
1′ 9″ Iron ore, greenish-gray.
26′ Massive gray sandstone.
5′ Red slate.
1′ 6″ Iron ore, greenish-gray.
14′ Gray micaceous thin bedded SS.
1′ Ferruginous sandstone.
38′ Gray sandstone.
7′ Gray slate.
3′ Red slate.
1′ Brown sandstone.
2′ Red slate.
15′ Gray slate.
16′ Gray sandstone.
5′ Red shale.
7′ Red slate.
45′ Gray sandstone.
Total, X......1,274′ 4″
9′ Red shale.
8′ Gray shale.
15′ Red shale.
12′ Brown sandstone.
25′ Red shale.
20′ Gray sandstone.

25′ Red shale.
196′ Concealed.
Red sandstone.
167′ Concealed.
30′ Brown shale.
50′ Brown sandstone.
35′ Red shale with three small layers of olive shale.
30′ Brownish-gray sandstone.
10′ Gray slaty sandstone.
30′ Reddish-brown sandstone.
3′ Red shale.
20′ + Yellowish-gray sandstone.
264′ Concealed and reddish sandstone and slate.
6′ Gray shale.
50′ Red shale and sandstone.
10′ Gray slaty sandstone.
265′ Red shale and sandstone.
20′ Red sandstone,
10′ Red shale.
15′ Red sandstone.
15′ Red shale and sandstone.
15′ Red sandstone.
80′ Red shale.
305′ Concealed.
15′ Gray shale.
14′ Red SS. with some gray shale.
10′ Red shale.
10′ Red and gray shale.
2′ Gray shale.
4′ Red sandstone.
15′ Red slate with some gray SS.
20′ Gray shale.
70′ Red shale.
5′ Gray sandstone.
40′ Red shale.
15′ Reddish-brown sandstone.
60′ Red shale with layers of gray sandstone.
25′ Gray sandstone with red shale; small layers of gray shale.
40′ Gray sandstone and slate.
480′ Concealed.
Total, IX......2560′
20′ Red slate with gray sandstone, mostly sandstone.
40 Gray slates.
20′ Gray sandstone.
3′ Gray slate.
20′ Gray sandstone.
40′ Gray slate.
90′ Gray sandstone and slate, with a slight reddish tinge.
40′ Gray sandstone and slate.
410′ Concealed.
192′ Gray slate.
8′ Gray sandstone.
10′ Light gray slate.
1′ Gray sandstone.
8′ Dark gray slates.
10′ Gray sandstone.
86′ Dark gray slates and concealed.
15′ Dark gray slates.
1′ Gray sandstone.
50′ Gray slates.
2′ Gray sandstone.
4′ Gray slate.
10′ Gray sandstone.
0′ 2″ gray slate.
1′ Gray sandstone.
70′ Gray slate.
300′ Concealed.
20′ Gray slate.
260′ Slaty sandstone.
20′ Gray shale.
30′ Gray sandstone and slates, thin bedded.
505′ Concealed.
50′ Gray sandstone thin bedded with slate.
460′ Gray slate with thin layers of gray sandstone.
50′ Gray slate.
50′ Concealed.
35′ Gray slate with a few layers of gray sandstone.
50′ Gray slate, cleavage planes iron stained.
780′ Concealed, mostly gray slates.
185′ Olive and gray slates with 10′ red slates.
5′ Red slates.
418′ Gray slate and sandstone.
75′ Slaty sandstone and gray slate.
10′ Gray sandstone.
100′ Gray slates, some of the slates have ripple marks.
600′ Gray slaty sandstone, thin.
1365′ Gray and black slates, the black slates are the lowest thickness not known.
Total, VIII......6519′ 2″
50′ ± Sandstone, coarse grained, some conglomerate. The thickness cannot be measured at any place in the county.
Total, VII......50′.
900′ Limestone, not all exposed, mostly a dark blue massive limestone.
Total, VI......900′.
120′ Gray slaty limestone.
30′ Concealed.
60′ Gray slate with some limestone.
5′ Dark gray slate.
14′ Slaty limestone.
1′ Limestone.

8′ Gray slate.
26′ Red shale.
1′ Gray slate.
0′ 10″ Limestone.
5′ Gray slate.
0′ 6″ Green shale.
1′ Red shale.
1′ Gray shale.
14′ Red shale.
5′ Gray slate.
1′ Impure limestone.
5′ Dark brown slate.
2′ Olive gray slate.
7′ Red slate.
45′ Gray slate with some small layers of limestone.
1′ 9″ Fossiliferous dark blue lime.
1′ 6″ Gray slate.
0′ 6″ Limestone.
4′ Gray slate.
0′ 2″ Limestone.
30′ Olive slate.
3′ Limestone.
3′ Gray slate.
2′ Limestone.
6′ Gray slate.
2′ Red shale.
3′ Olive shale.
6′ Red shale.
2′ Green shale.
3′ Red shale.
2′ Olive shale.
6′ Red shale.
5′ Gray shale.
30′ Gray slate and concealed.
50′ Concealed. Fossil ore.
20′ Gray slate.
30′ Concealed.
30′ Brown slate.
640′ Concealed. Frankstown fossil ore in this interval.
Total V, 1328′ 3″.

100 ± White sandstone.
255′ Red sandstone with layers of red slate from 6″ to 5′ thick.
84′ Massive red sandstone.
1′ 8″ Green slaty sandstone.
87′ Red sandstone with a few layers of red shale.
0′ 6″ Green slate.
10′ Red sandstone.
5′ Red shale.
5′ Green slate.
5′ Red sandstone.
20′ Gray sandstone.
1′ Red shale.
10′ Gray sandstone.
0′ 6″ Red shale.
10′ Red sandstone.
15′ Grayish-red sandstone.
1′ Red slate.
1′ 6″ Green slate.
15′ Gray sandstone.
1′ Gray slate.
20′ Brown sandstone.
1′ Gray slate.
8′ Brown sandstone.
0′ 6″ Red shale.
75′ Reddish-brown sandstone.
1′ Red slate.
200′ Red and gray sandstone.
9′ Red sandstone.
4′ Red shale.
2′ Red sandstone.
3′ Red slate.
1′ Green slate.
4′ Red slate.
2′ Green slate.
6′ Red sandstone.
15′ Red sandstone (some gray).
10′ Red sandstone.
2′ Gray slate.
18′ Red sandstone.
0′ 5″ gray slate.
12′ Grayish-brown sandstone.
0′ 3″ Red shale.
20′ Brown sandstone.
0′ 2″ Green shale.
4′ Brown sandstone.
1′ Red shale.
150′ Brown and gray sandstone and concealed.
409′ Concealed and gray sandstone.
320′ Gray sandstone.
440′ Gray sandstone and slaty SS.
Total, IV......2365′ 10″

900′ Slates, gray and black, they do not show in any place in the county.
Total, III......900′

5400′ Limestone, dark blue, blue, and gray.
40′ ± White sandstone, some of it iron-stained.
1160′ Limestone, towards the bottom comes in slates and SS.
Total, II & I (?)......6600′

The Coleoptera of Florida.

By E. A. Schwarz.*

(*Read before the American Philosophical Society, Feb.* 1, 1878.)

The following list is founded upon material collected during two expeditions to Florida. In the spring of 1875 collections were made at Haulover near the northern end of Indian River from February 23d to March 20th, at Ft. Capron, on the same lagoon about a hundred miles south of Haulover, from March 26th to April 28th, at Enterprise on the upper St. Johns River from May 7th to 28th, at Cedar Keys, on the gulf coast, from June 2d to 9th. In the following year collections were made at Tampa from March 24th to April 30th, and again at Enterprise from May 15th to June 27th.

On both trips smaller collections were made at various points: Fernandina April 16th, Palatka February 13th, Sand Point on the Indian River February 19th to 22d, Lake Harney on the upper St. Johns River in the beginning of May, at Baldwin on the Jacksonville and Mobile R. R. on June 1st and June 10th, Lake Ashby in Volusia County and New Smyrna in the beginning of June. A number of interesting species were also obtained on the journey across the peninsula from Tampa to Enterprise during the first half of May.

As the localities where the most extensive collections were made differ greatly in character, and as no points in north-western Florida, nor at the southern extremity of the peninsula were visited, I must abstain from drawing any conclusions concerning the local distribution of Coleoptera in Florida. The sandy plains at Haulover, covered with scrub-oak and saw-palmetto, were not found elsewhere; the ocean and lagoon beaches of the eastern shore, especially at Capron, are rich in peculiar forms, and as the Gulf Stream here flows only six or eight miles off the coast, it is quite possible that many of these species are direct importations brought in the West Indian seeds and drift-wood constantly being thrown upon this low and sandy coast.

The Coleoptera from Enterprise represent the fauna of the "hammocks," a term applied in Florida to the dense hard-wood and palmetto forests, as distinguished from the open and sandy pine lands or cypress swamps. At Tampa special attention was paid to the fauna of the pine forests. In all districts covered with pine woods occur depressions, which in the dry season become swampy meadows, with a fauna remarkably rich in species and in specimens, and nearly identical in character throughout the State.

Notwithstanding the very uniform temperature during the entire year, the dry season, which corresponds with the winter months, causes a disappearance of insects in Florida almost as complete as in the north; in the beginning of March they appear suddenly with the first leaves of the oak, but there is no spring flight of Coleoptera. The beginning of the rainy season about the end of May brings out the full summer fauna.

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* With additional descriptions of new species by John L. LeConte, M. D.

Though far from complete, the following enumeration of species is judged sufficiently extensive to give a tolerably clear idea of the character of the Floridian fauna.

I desire to express my indebtedness to Dr. LeConte, without whose aid in the determination of species, this list could not have been prepared.

The following abbreviations for localities are used in the List of Species.

A.—Lake Ashby.
B.—Baldwin.
C.—Ft. Capron.
E.—Enterprise.
F.—Fernandina.
H.—Haulover.
K.—Cedar Keys.
L.—Lake Harney.
N. S.—New Smyrna.
P.—Palatka.
S.—Sand Point.
T.—Tampa.
*—Species recorded from Florida not collected by myself.

Descriptions of New Species.

By E. A. Schwarz.

1. **Lebia rhodopus,** n. sp.—Head and thorax greenish or bluish black, subopaque; the former large, wider than the thorax, finely alutaceous, sparsely and obsoletely punctulate; antennæ more than half the length of the body, outer joints stout, joint 3 and base of joint 4 testaceous; palpi black. Thorax small, transverse, on the sides very little rounded and subsinuate before the hind angles, which are rectangular; side margin less broadly reflexed than in *L. viridis;* finely alutaceous, indistinctly transversely rugose or obsoletely punctulate. Elytra blue or greenish blue, shining, very finely alutaceous, striæ finer and more obsolete than in *L. viridis*, interstices subconvex. Beneath bluish black, legs, including the coxæ, bright rufo-testaceous, tarsi blackish, claws pectinate. Length 4.5 mm.; .17–.18 inch.

Allied to *L. viridis* and *pumila*; from the former distinguished by its larger head, which as well as the thorax, is hardly shining, and by the color of antennæ and legs; from the latter by its larger size and the coloration of the upper side and of the legs; from either species by the long and stout antennæ.

Two specimens from Tampa, found in April on the blossoms of Chamærops serrulata.

2. **Apenes angustata,** n. sp.—Shining, head and thorax metallic green, elytra dark coppery; beneath black, antennæ, palpi and legs testaceous. Head a little narrower than the thorax, longitudinally strigose,

with some scattered punctures, clypeus alutaceous, minutely and sparsely punctulate. Thorax in front but little wider than long, at the sides less rounded and less narrowed behind than in *A. lucidula;* hind angles indicated by an interruption of the reflexed margin, transversely rugulose and sparsely punctulate, near the front margin more evidently punctate, punctures sometimes confluent in longitudinal rugosities. Elytra of a dark coppery color with an oblong yellow spot at the base of the 6th interval, finely but deeply striate, striæ distinctly punctulate, interstices flat, alutaceous, sparsely and obsoletely punctured. Length 9.25 mm.; .37 inch.

Of the same size as *A. lucidula*, but narrower and with a different form of the thorax; the sculpture of head and thorax is finer, the elytra are darker colored with the scattered punctures on the interstices less evident.

Enterprise; three specimens, apparently females.

CYCLONOTUM.

The four North American species before me may be distinguished by the following table:

I. Antennæ with more or less solid club; prosternum carinated in front, prolonged behind between the coxæ and almost reaching the mesosternum; first ventral segment carinate; elytra with distinctly impressed sutural striæ at apex:

Antennal club solid, prosternum very short in front of the coxæ: metasternum in the middle slightly but abruptly raised in an oblong shining plate, which is narrowed in front. Size small, rows of punctures on the elytra very obsolete.............. **palmarum.**

Antennal club less solid, prosternum moderately long in front of the coxæ, metasternum with an oblong, not elevated, not pubescent, opaque spot. Size large, elytra with regular rows of punctures.. **cacti.**

II. Antennæ with a loosely jointed club of three joints, prosternum feebly prolonged between the coxæ; metasternum strongly longitudinally carinated, carina shining, more or less punctulate, but not sharply limited laterally; first ventral segment not carinated; elytra without sutural stria.

Larger, rounded-oval, elytra moderately densely punctulate, legs piceous black, tibiæ distinctly punctulate .... **estriatum.**

Smaller, rounded, almost hemispherical, elytra less densely punctulate, legs stouter, piceous red, tibiæ smooth......... **semiglobosum.**

3. **Cyclonotum palmarum,** n. sp.—Rounded-oval, convex, above black, shining, anterior part of head, sides of thorax and tip of elytra sometimes red, beneath red, metasternum darker in the middle, antennæ, mouth and legs bright rufo-testaceous. Head very finely aciculate and

obsoletely remotely punctulate, antennæ with the first joint elongated, but much less so than in *C. cacti*, 2d joint as thick as the first, longer than wide, 3d much narrower but also longer than wide, 4th very small subtransverse, 5th and 6th very small strongly transverse; the three last joints are absorbed in a large, elongate-oval, solid annulated club, which is almost as long as the first joint and less compressed than in *C. cacti*. Mentum transverse, flat, subopaque, testaceous, not visibly punctured, broadly emarginate in front. Prothorax sculptured as the head, broadly emarginate in front, sides feebly rounded, base straight, anterior angles distinct, not rounded, hind angles obtuse. Scutellum shining, very finely sparsely punctulate. Elytra shining, not densely, finely punctured, with traces of rows of stronger punctures at the apex near the side margin; sutural stria finely impressed and reaching almost to the middle. Prosternum in front of the coxæ very short, linear, carina more prominent in front, intercoxal process long, almost reaching the mesosternum. Carina of mesosternum with the free angle almost rectangular, not mucronate. Metasternum on each side opaque, not visibly punctured, in the middle slightly but abruptly elevated in an oblong, shining plate, which is somewhat narrowed in front and finely remotely punctulate. Abdomen opaque, first segment carinated in the middle. Legs stout, femora punctulate, tibiæ smooth. Length 1.75 mm.; .07 inch.

Enterprise; five specimens, found in May and June, on cut down palmetto trees feeding on the fermenting juice.

C. semiglobosum Zimm. (Trans. Am. Ent. Soc. 1869, p. 250), is in my opinion well distinguished from *C. estriatum*. It is always smaller, shorter and more convex, the front margin of thorax distinctly produced in the middle, the punctation of head and thorax is much finer, that of the elytra less dense, fine in the scutellar region, stronger at apex and at the sides; the legs are stouter and less dark colored, the tibiæ smooth.

4. **Sacium mollinum**, n.sp.—Elongate-oval, shining, above piceous, thorax semicircular with the apex and sides pale, diaphanous anteriorly, finely and moderately densely punctulate. Elytra minutely sparsely punctulate, pubescent, a humeral spot, a curved fascia at the apical third, and the side margin yellowish-testaceous. Beneath piceo-testaceous, abdomen and legs pale, metasternum densely punctulate. The yellow side margin is connected with the humeral spot and with the fascia; the latter is sometimes abbreviated at the sides or reduced to a spot on the disc. Length 1 mm.; .04–.05 inch.

Tampa and Enterprise, many specimens; abundant on Pinus palustris in April and June. Shorter and more regularly oval than the other species and of different coloration.

5. **Sacium splendens,** n. sp.—Elongate-elliptical, very shining, thorax semicircular, reddish with an indefinite dark spot in front of middle, apex and sides pale, very finely sparsely punctulate. Elytra piceous-black with an indistinct reddish basal spot inside of the humerus and a common, broad, testaceous fascia behind the middle, exceedingly finely remotely punctulate, pubescence only visible under a very high power. Underside reddish-brown, shining, hardly visibly punctulate, abdomen paler at apex, legs yellowish-testaceous. Length 7 mm. ; .03–.04 inch

Tampa; many specimens beaten from dead leaves of Pinus palustris in April. Varies with the fascia interrupted by the suture, or not reaching the side margin. The apparently unpubescent and very shining elytra with the very fine punctuation will easily distinguish this species.

6. **Scydmænus divisus,** n. sp.—Fusiform, shining ; head and thorax brown, impunctate, with coarse, erect, moderately long, brownish pubescence. Head not immersed in the thorax, with a thick brush of hairs each side behind the eyes ; antennæ red, stout, longer than head and thorax, intermediate joints as long as wide, club 4-jointed, 8th joint globular twice as large as the preceding, joints 9 and 10 subtransverse, each very little larger than the 8th, terminal joint oval, shorter than the two preceding together ; maxillary palpi with the penultimate joint slender, clavate, last joint not visible. Thorax trapezoid, very little longer than wide at base, smooth, transverse basal impression feeble, interrupted at the middle. Elytra not forming an angle with the thorax, with sparse, long, erect, grayish pubesence, red, evidently punctate anteriorly and smooth behind the middle ; punctate part divided in an inner and outer portion by a broad smooth humeral band, inner portion more finely and sparsely, outer portion more coarsely and densely punctured ; humeral callus moderately elevated ; two distinct basal foveæ each side of almost equal size ; suture not elevated. Beneath piceous, abdomen pale at tip, legs red, femora moderately clavate. Length 1.15 mm. ; 4.5 inch.

Enterprise; two specimens. Belongs in the group of *S. capillosulus* and is easily distinguished by the peculiar sculpture of the elytra.

7. **Languria marginipennis,** n. sp.—Red ; head, and small rounded discoidal spot on the thorax, scutellum, outer half of femora, the larger part of the tibiæ and the tarsi blackish-green; antennæ, metasternum, with the exception of the front margin, and the last ventral segment black; elytra greenish-blue or blue, margin and epipleuræ red. Head alutaceous, distinctly not densely punctured, antennæ with joints 3–6 slender, 7–11 forming an abrupt club, joints 7–10 produced within. Thorax longer than wide, finely aciculate and distinctly not densely punctured, on the sides very little rounded and slightly sinuate before the hind angles ; the

more or less rounded spot in the centre and occupies usually the fourth part of the length of the thorax, but is in some specimens reduced in size. Elytra shining, strongly striate-punctate, punctures finer towards the apex, interstices flat, finely alutaceous, obsoletely remotely punctulate; the red color is usually confined to the thickened margin and to the epipleuræ, but in two specimens the last interstice also is indistinctly red in the middle. Prosternum sparsely punctured, almost smooth in front, mesosternum coarsely punctured, metasternum almost smooth, abdomen finely, remotely punctulate. The red and green colors on the tibiæ are not sharply separated; the base and the upper edge, however, are always dark and the largest part of the lower edge always red. Length 7–9 mm.; .28–.35 inch.

Ft. Capron, Tampa, and Enterprise; six specimens. This species resembles in form *L. tædata*, it is, however, a little more elongate with the thorax longer.

8. **Tomarus hirtellus**, n. sp.—Oblong-oval, convex, shining, fusco-testaceous. Head and thorax finely, sparsely punctulate, sparsely pubescent; antennæ less slender than in *T. pulchellus*. Thorax twice as wide as long, on the sides subsinuate before and slightly undulate behind the middle, base sinuated each side, basal impressions deep. Elytra with sparse, suberect, grayish pubescence, and with some scattered long erect hairs, strongly irregularly punctate in front, punctures becoming finer and obsolete towards the apex; an indefinite, often abbreviated, fascia at the middle and another on the apical third black. Beneath finely, sparsely pubescent, pro- and metasternum evidently punctulate; legs pale. Length 1.25–1.5 mm; .05–.06 inch.

Smaller and shorter than *T. pulchellus* and easily distinguished by its more evident pubescence and stronger punctuation on the elytra. The pubescence of *T. hirtellus* and the form of the thorax, whose side margin has the tendency to become serrulate, bring the genus *Tomarus* still nearer to *Paramecosoma*.

9. **Lathropus pictus**, n. sp.—Opaque, head and thorax ferrugineo-testaceous, the former densely rugosely punctulate, emarginate in front, antennæ ferrugineous, second joint and the club blackish, joints 3—8 very small, together hardly as long as the club. Thorax transverse, side margins undulate, apical margin and base straight, anterior angles almost rectangular, hind angles prominent; finely and densely rugosely punctulate, without any trace of impressions, lateral lines feeble. Scutellum small, transverse. Elytra much less elongate than in *L. vernalis*, fusco-testaceous, finely punctate-striate, with numerous rows of exceedingly short, rigid, whitish hairs; a circumscutellar cloud and a common fascia, concave and dentate anteriorly, blackish. This fascia is formed of three indefinite spots on each elytron, the first at the suture a little behind the

middle, the second, oblong, in front and outside of the first, the third at the side margin. Metasternum and abdomen piceous, finely sparsely punctulate; legs pale. Length .05 inch; 1.25 mm.

Smaller and especially shorter than *L. vernalis* and distinct by the disc of the thorax without impressions, by the sculpture and pubescence of the elytra and by the color.

Haulover Canal, Volusia County; four specimens found under bark of a dead Quercus virens.

10. **Læmophlœus Chamæropis,** n. sp.—Less elongate, depressed, glabrous, shining, bright rufo-testaceous, elytra pale ochreous. Head large, transverse, flat, not impressed on the disc and without median line, finely and sparsely punctulate, marginal line close to the margin in front and at the sides, base not margined; antennæ with distinct 3-jointed club; labrum large, transverse, truncate in front. Thorax finely, sparsely punctulate, with a single lateral line joining the basal marginal line and with an impressed puncture of moderate size each side in the middle outside of the lateral line; anterior angles not prominent in either sex. Scutellum transverse, triangular. Elytra at base very little wider than the thorax, slightly dilated behind the humeri, which are obtuse but not rounded; each elytron with six fine striæ: the humeral stria more distinct and impunctate, 5th stria also more distinct, obsoletely punctulate, the inner striæ less distinct and feebly punctulate, sutural striæ at apex more impressed than in front. Interstices flat impunctate. Head beneath, pro- and mesosternum impunctate, metasternum and abdomen finely sparsely, last ventral segment more densely punctulate. Length 1.5–2 mm.; .06–.08 inch.

♂ Head wider than the thorax, front produced, emarginate at middle, distinctly sinuate each side, with the teeth long and acuminate; antennæ slender, more than half the length of the body, with all the joints longer than wide. Thorax strongly transverse, sides oblique, convergent towards the base and subsinuate before the hind angles, which are obtuse; lateral line oblique; elytra as long as head and thorax together.

♀ Head as wide as the thorax, front produced, emarginate in middle, hardly sinuate at the sides, teeth much less prominent; antennæ less slender, outer joints as long as wide. Thorax less transverse, sides sub-parallel, slightly arcuate and sinuate before the hind angles, which are rectangular, lateral line straight; elytra a little longer than head and thorax together.

11. **Nemicelus marginipennis** Lec.—The two sexes differ from each other most remarkably and might be easily mistaken for two distinct species. The form described by LeConte (Proc. Ac. Nat. Sc. 1854, p.79). I take to be the ♂. The female differs chiefly by the following characters : Less elongate, opaque above, color of upper and underside darker. Head densely rugosely punctulate with an obtuse tooth behind the eyes, eyes smaller, less elongate and less oblique, more convex ; antennæ with the first joint only one-half longer than wide, shorter than the two following together. Thorax hardly longer than wide anteriorly, more dilated in front, not emarginate at apex, apical edge thickened, base much less lobed in the middle, surface densely rugosely punctulate. Elytra almost entirely covering the abdomen, less truncate at apex, distinctly pubescent, densely punctulate, striæ less evident. Prosternum shining, punctate, process between the front coxæ hardly visible, propleuræ opaque, sculptured as the thorax; mesosternum much smaller, less broadly rounded in front, dilated behind, shining punctate ; metasternum and abdomen opaque, the latter less elongate, last segment not longer than the preceding with a large shallow impression. Hind tarsi 4-jointed as in the male.

The genus *Nemicelus* was first described by Dr. LeConte, and is certainly distinct from *Hemipeplus*.

12. **Nemicelus microphthalmus,** ♀ n.sp.—Linear, pale, yellow-testaceous. Head quadrate, subconvex, behind the eyes straight, then suddenly narrowed and forming a short neck, somewhat shining, sparsely and obsoletely rugose ; eyes small, round, convex, very coarsely granulated, mandibles deeply emarginate and black at tip ; antennæ a little longer than head and thorax, first joint stout one-half longer than wide, shorter than the two following together, joint 2 globular, the following 4 joints as long as wide, equal, 7 and 8 a little larger than the preceding, the three last joints abruptly larger, 9 and 10 hardly transverse, terminal joint oval acuminate. Thorax but little longer than wide anteriorly, feebly and broadly emarginate in front, sides oblique, convergent towards the base, subsinuate anteriorly and broadly sinuate before the hind angles ; base almost straight, not lobed, apical edge thickened, anterior angles obtuse; rounded at tip, posterior angles obtuse ; surface somewhat shining, indistinctly, rugosely punctulate with a faint trace of an impressed median line, basal impressions large and deep. Scutellum opaque, subquadrate and a little broader behind, apical side rounded. Elytra almost covering the abdomen, subopaque, paler than the head and thorax, darker at the sides and with a short dark line on each elytron near the suture at the apical fourth, densely and equally rugosely punctulate with hardly any trace of striæ. Pro- and mesosternum shining, sparsely punctulate, propleuræ opaque, sculptured as the thorax, front coxæ very narrowly separated, metasternum and abdomen subopaque densely and finely punctulate, last ventral segment hardly longer than the preceding with a round impression, occupying nearly the whole surface. Length 3.25 mm. ; .13 inch.

♂ Unknown to me.

A single specimen from Enterprise, found in May, attracted by the light, is before me, another specimen from Tampa is in the cabinet of Dr. LeConte. Smaller and narrower than the smallest females of *N. marginipennis* and very distinct, especially by the form of the head and by the small, round eyes.

13. **Philothermus puberulus,** n. sp.—Elongate-elliptical, transversely convex, dark chestnut-colored, shining, above with distinct, fine, erect pubescence and with some longer hairs at the sides. Head sparsely punctured, antennæ shorter than in *Ph. glabriculus*, apparently 10-jointed, joints 2 and 3 slender, the following six joints small, 7–9 strongly transverse, joints 10 and 11 forming a solid club as in *Cerylon*. Thorax less transverse and less strongly margined than in *Ph. glabriculus*, rounded on the sides, moderately sparsely punctured. Scutellum transverse, shining, with a few punctures. Elytra strongly striate-punctate, interstices finely, sparsely punctulate. Prosternum and propleuræ distinctly, not densely, metasternum and first ventral segment in the middle finely and sparsely, at the sides very coarsely punctured, segment 2–4 each with two transverse rows of strong punctures, last segment more finely punctulate; legs testaceous. Length 2 mm.; .075 inch.

Abundant in Florida under old bark of Pinus palustris. Smaller, narrower and more convex transversely than *Ph. glabriculus*, with the sculpture above and beneath stronger and at once distinguished by the much more evident pubescence and by the form of the antennal club. By this last character *Ph. puberulus* forms a passage to *Cerylon*. Sexual characters are not evident; some specimens have the sides of thorax less rounded; these are probably the males.

14. **Olibrus princeps,** n. sp—. Rounded-oval, pale rufo-testaceous, thorax with a large brownish discoidal spot. Elytra black each with a large, oval, bright orange-colored spot at the suture before the middle, outer half of the basal margin and the lateral margin narrowly, apex broader yellow; very finely striate, striæ minutely and remotely punctulate, interstices obsoletely sparsely punctulate, punctures more distinct near the lateral margin. The sutural stria alone is deeper impressed; mesosternum not protuberant. Length 2.5 mm.; .10 inch.

One specimen in the collection of Mr. H. G. Hubbard from New Smyrna; another specimen found by me at Enterprise in May is in the cabinet of Dr. LeConte. A very striking species by its color, belonging in the group of *O. apicalis*.

15. **Brachyacantha querceti,** n. sp.—Rounded, convex, shining, black ; head and thorax finely not densely, elytra somewhat more strongly punctured. Each elytron with a large, transverse humeral spot, which is obliquely truncate inside and leaves a very narrow basal margin black and with a smaller, rounded-oval spot at the outer apical angle not touching the margin, orange-red. Side pieces of metasternum and sides of abdomen densely punctured, propleuræ and legs yellow, femora infuscate at base. Length 2–2.75 mm. ; .08–.11 inch.

♂ Head, front margin of thorax narrowly, anterior angles and side margins more broadly, epimera of mesosternum entirely whitish-yellow.

♀ Head black, or piceous in front, thorax black or with the front margin and front angles narrowly piceous-testaceous, epimera black or piceous.

var. *α* Humeral spot small and narrow.

var. *β* Humeral spot interrupted at middle.

Widely distributed in Florida ; abundant on oak shrubs.

16. **Hyperaspis paludicola,** n. sp.—Oblong-oval, less convex, black ; head subopaque, finely alutaceous, obsoletely sparsely punctulate; thorax opaque, sides yellow, sculptured as the head. Elytra shining, distinctly moderately densely punctate, an oval discoidal spot, the side margin and the apex yellow. The yellow side margin is throughout of equal width, following the undulation of the side margin of the elytra ; at the apex it turns inwards and becomes broader, but does not reach the suture. Mouth, antennæ, epipleuræ, legs, sides and apex of abdomen, yellow. Length 1.35–2.25 mm. ; .07–.09 inch.

♂ Head and front margin of thorax yellow.

Very common in Florida on swampy meadows in the Pine lands. Resembles in coloration certain varieties of *H. undulata*, but it is longer, less convex and also a little smaller, with the thorax opaque and less distinctly punctulate; the yellow side margin is always of equal width and never broken into spots.

17. **Strigoderma exigua,** n. sp.—Oblong-oval, convex, shining, above glabrous and only at the sides fringed with a row of longer hairs. Head piceous with greenish reflection, transversely convex behind, flattened in front, moderately sparsely punctate and not rugose, vertex more remotely punctulate; clypeus parabolical, not separated from the front, broadly rounded at apex and strongly reflexed ; antennæ piceous. Thorax transversely convex, emarginate at apex, at the sides strongly rounded and narrowed in front of middle, not angulated in the middle, slightly narrowed towards the base, which is straight and not produced in the middle; hind angles obtuse, rounded; surface piceous with greenish reflexion, apex and sides pale ochreous, sparsely punctured without impressions. Elytra fusco-testaceous, punctate-striate, alternate intervals more elevated, con-

vex, smooth, pale ochreous-yellow. Beneath piceous, with sparse long pubescence, legs testaceous, femora infuscate; front tibiæ not dentate, the apical tooth being a mere prolongation of the outer apical angle in the axis of the tibiæ, upper edge therefore almost straight, only very slightly sinuate at the base of the apical process, outer side neither carinate nor sulcate, smooth with exception of a row of punctures along the upper edge; first four tarsal joints short, claws strongly incurved at base Length 4–4.5 mm.; .16–.18 inch.

Three specimens are before me which I found on oak shrubs on the sand hills east of Lake Altapopka in May. Easily distinguished from our two other species by its smaller size, more regularly oval, convex form, by the glabrous upper surface, by the sculpture of head, thorax and elytra and by the formation of the front tibiæ.

18. **Taphrocerus puncticollis,** n. sp.—Elongate, above blackish-blue, or black with faint æneous tinge, shining. Head less strongly excavate, very finely alutaceous, distinctly, moderately sparsely punctate, punctures deeper than in *T. gracilis*. Thorax transverse, narrowed in front when viewed from above, sides sinuate before the hind angles, which are rectangular, base strongly lobed in the middle, lobe broadly emarginate; surface uneven with a distinct carina in front of the hind angles, very finely alutaceous, coarsely unequally punctured, each puncture bearing a very short scale-like hair. Scutellum transverse, shining. Elytra impressed at base, impressions on the disc not obvious, serrate at the outer apical angle; anteriorly moderately strongly striate-punctate, punctures obsolete towards the apex, each with a very fine, short hair, interstices on the disc unequal; the striæ therefore appear subgeminate; humeral carina broadly interrupted at middle. Beneath bluish-black or black, metasternum coarsely punctured; abdomen with sparse shallow punctures, last segment with a deep, semicircular marginal sulcus. Length 5 mm.; .20 inch.

Enterprise and Cedar Keys; two specimens. More elongate than *T. gracilis* and distinguished by the deeper punctuation of head, thorax and metasternum and by the elytra less even, without patches of pubescence; from *T. agriloides* it differs chiefly by the form of the thorax, which in the latter species is not narrowed in front when viewed from above.

19. **Brachys fascifera,** n. sp.—Similar to *B. ovata*, but shorter, broader in front and more attenuate behind, and easily distinguished by the broad white fascia on the elytra and by the formation of the prosternum. Head and thorax as in *B. ovata*, the former less strongly excavated. Elytra striate-punctate, punctures finer and obsolete towards the apex, anteriorly with irregular lines and patches of fulvous and whitish pubescence.

behind the middle with a broad fascia of dense whitish pubescence, with only a few fulvous hairs intermixed; behind this with two other undulated fasciæ composed of fulvous hairs bordered anteriorly with white; humeral and marginal carina as in *B. ovata.* Fissure of prosternum not reaching the hind margin, but leaving a comparatively broad margin intact, apex of metasternum in the middle suddenly and deeply emarginate. Last ventral segment with the usual marginal sulcus, not emarginate in the male; broadly rounded in the ♀, less broadly in the ♂; anus very finely pectinate. Length 4.5–5 mm.; .18–.20 inch.

Widely distributed in Florida and not rare; lives on Quercus virens. In *B. ovata* and *tesselata* the undivided portion of the prosternum is very narrow and the metasternum is broadly triangularly emarginate in front.

20. **Pachyscelus cæruleus,** n. sp.—Short ovate, black, head and thorax bluish-black or black with æneous tinge, scutellum and elytra bright blue, shining. Head deeply channeled, alutaceous, obsoletely punctulate, thorax without lateral depression and with sparse shallow punctures almost obliterated on the disc, more obvious at the sides, finely alutaceous at the sides. Elytra with a deep impression at the sides before the middle, and with another obsolete one near the suture behind the middle, plainly punctured, with traces of regular rows on the disc. Length 2–3 mm.; .08–.12 inch.

♂ Last ventral segment with an oblong impression at apex, apical margin produced in the middle into two prominent processes each of which terminates in four small teeth.

♀ Last ventral segment not impressed, apical margin produced in the middle in an acute point.

Very abundant everywhere in Florida. In form and size this species resembles *P. lævigatus;* the elytra are however less triangular and more rounded at the sides; it differs also by its color and by the thorax not being impressed at the sides. Very probably there will also be a difference in the sexual characters of the males but I have not seen the ♂ of *P. lævigatus.* In *P. purpureus* the last ventral segment of the ♂ has a similar impression but the two processes are more separated from each other and each terminates in three teeth.

21. **Temnopsophus impressus** n. sp.—Black, shining; head piceous or piceous-red, finely alutaceous and sparsely punctulate with a fine median line on the vertex, antennæ two-thirds as long the body, piceous-red at base. Thorax almost longer than wide in front, strongly convex,

transversely depressed before the base, strongly rounded at apex and produced in the middle, at the sides rounded anteriorly, towards the base narrowed and subsinuate; base distinctly emarginate and finely margined; surface piceous or piceous-red, smooth in the middle, finely alutaceous and obsoletely punctulate towards the sides. Scutellum semicircular, opaque. Elytra elongate-oval, widened behind, basal third strongly depressed and transversely impressed, apical two-thirds ventricose, convex, sides sinuate in front of middle; color black with a large yellow marginal spot behind the humerus, base frequently piceous-red; depressed part coarsely, densely, ventricose part sparsely punctured, each puncture bearing a short whitish hair. Legs piceous-black or piceous-red, hind tibiæ slender, slightly curved. Length 2–2.5 mm.; .08–.10 inch.

♂ Sides of head in front of eyes straight, convergent anteriorly, antennæ with the first joint formed as in the ♂ of *T. bimaculatus*, elytra more elongate, less ventricose behind.

♀ Sides of head rounded anteriorly, first joint of antennæ not dilated, a little longer than the two following together, elytra strongly convex and ventricose behind.

Eight specimens are before me, found on the meadows north of Lake Ashby, Volusia county, in June.

The yellow humeral spot extends sometimes so as to nearly reach the suture.

Easily known from *T. bimaculatus* by the form of the elytra.

22. **Eupactus viticola,** n. sp.—Piceous or piceous-red, glabrous, shining. Head distinctly punctulate, frontal lines before the eyes, and transverse suture evident; clypeus opaque, rugosely punctulate; eyes not prominent, moderately coarsely granulated. Antennæ piceous-red; first joint large, shining, punctulate, strongly curved, narrowed towards the extremity; second joint as wide as the first, as long as wide, not curved inwards; joint 3 as large as joint 2, triangular; joints 4, 6 and 8 very small, strongly transverse; joints 5 and 7 a little larger, strongly transverse, and produced inwards; last three joints strongly compressed, the 9th twice as long as wide, as long as 2–8 together, and as long as 10 and 11 together, outer margin straight, inner margin convex, inner front angle somewhat produced, inner basal angle rounded; joint 10 longer than wide, truncate at tip, outer margin straight, inner margin strongly sinuate at the basal half; joint 11 closely applied to the 10th, as long as wide, rounded at tip; maxillary palpi with the last joint large, triangular. Thorax anteriorly a little wider than long in the middle, very convex transversely, apical margin slightly produced at middle, and feebly sinuate each side, sides straight, strongly convergent in front, base lobed at middle, feebly sinuate each side; front angles strongly deflexed, acute, but not prominent, hind angles obtuse, rounded; finely, sparsely punctulate, more densely towards the anterior angles, and with an impressed marginal line at the sides. Scu-

tellum acuminate at apex, sides rounded with a few fine punctures. **Elytra** with an indefinite longitudinal impression at the sides behind the middle, suture very feebly elevated behind the scutellum, very finely and sparsely punctulate, punctures on the disc hardly visible, and with a single, sometimes obsolete, row of fine punctures not far from the suture on the basal half. Metasternum shining, very finely; remotely punctulate, coxal plates hardly widened externally, evidently punctate. First ventral segment finely and sparsely punctulate, excavated parts opaque, rugose, second segment longer than the first, very finely and remotely punctulate; third and fourth segments of equal length, each shorter than the second, and similarly punctulate, punctures denser and stronger at the sides; last segment as long as the second, moderately sparsely punctulate. Length 2–3 mm.; .08–.12 inch.

Enterprise, many specimens beaten in June, from dead vines of a species of Vitis.

23. **Metachroma maculipenne** n. sp.—Oblong, convex, shining. Head testaceous with the ocular sulci strongly marked, meeting in the middle, and with a distinct median line; clypeus coarsely punctured, broadly emarginate anteriorly, front less coarsely and less densely punctured; labrum trilobed, middle lobe triangular, lateral lobes broad, truncate. Thorax transverse, convex, at apex a little produced, at the sides strongly rounded and margined; anterior angles auriculate, posterior angles dentiform, prominent; brownish-red with three indefinite spots often confluent in an M-like mark; coarsely, not densely punctured, on the disc finely, at the sides more distinctly alutaceous. Scutellum piceous, smooth, or with a few punctures. Elytra parallel at the sides, broadly rounded at apex, strongly, regularly striate-punctate, punctures fine at apex; interstices very finely, remotely punctulate, eighth insterstice broad, including two striæ; fusco-testaceous, suture infuscate, each elytron with three black spots: one at the margin behind the humerus, the second on the fifth interstice before the middle, the third between the sixth and eighth stria a little behind the middle. Epipleuræ of thorax black, smooth; metasternum piceous, shining, sparsely rugose; abdomen reddish-testaceous, sub-opaque, alutaceous and obsoletely punctate; legs pale. Length 3.5–4.25 mm.; .14–.17 inch.

Enterprise, many specimens found in June, mostly on Quercus virens. This species resembles very much certain varieties of *Paria sexnotata*.

24. **Chrysomela Cephalanthi,** n.sp.—Oval convex; head opaque; brown, almost smooth, maxillary palpi with the last joint a little longer than in *C.similis*, but not dilated. Thorax short, emarginate at apex, straight at the sides, uniformly brown, opaque, with a few scattered punctures on the disc, side margin not thickened, coarsely punctured. Elytra yellow, shining, with three regular brown vittæ not joining each other: one on

the suture not abbreviated, but very little narrower at apex than in front and including two regular striæ of moderately coarse punctures; the second and third abbreviated at base and apex, the former limited each side by a regular stria of punctures and including two short irregular striæ behind the middle with a few punctures in front; the outer vitta is margined interiorly with a stria of punctures and includes two long almost regular striæ; the outer marginal stria is broadly interrupted at middle; the yellow parts are impunctate with the exception of a humeral line of very fine punctures. Underside, including the epipleuræ, brown with scattered moderately fine punctures; legs very coarsely punctured, claw joint not dentate, claws stout, distant. Length 6–7.25 mm.; .24–.29 inch.

Ft. Capron and Lake Harney, two specimens; also found at Tampa; lives on the Button Bush. Belongs to *Calligrapha* Er. and is to be placed near *C. similis*, from which it differs by its more elongate form, by the straight side margin and less punctured disc of the thorax, by the regular vittæ and sculpture of the elytra and by the coarsely punctured legs.

25. **Systena pallipes,** n. sp.—Elongate-elliptical, convex, shining, black; head and thorax often reddish-brown, base of antennæ and legs pale testaceous. Head carinate in front, impressed median line fine, smooth anteriorly; sculpture of posterior part variable, either finely, remotely punctulate or more coarsely punctate with indistinct transverse rugæ. Antennæ pale, the last four or five joints black, second joint slender, twice as long as wide. Thorax as in *S. frontalis*, but much more convex transversely, sculpture variable, either shining, finely, sparsely punctate, or less shining, alutaceous, with the punctures coarser and less sparse. Scutellum smooth, shining. Elytra elongate, very little broader at base than the thorax, humeri rounded, shining, evidently not densely punctate, with traces of an impressed sutural line. Length 3–4 mm.; .12–.16 inch.

Many specimens from different parts of Florida, abundant on the swampy meadows in May and June. More elongate, narrower and more convex than *S. frontalis*, with the elytra narrower at base, and easily distinguished by its pale legs.

26. **Epitrix brevis,** n. sp.—Short-ovate, black, shining, antennæ, mouth and legs red, posterior femora infuscate. Head impunctate; thorax shining, more finely punctulate than in *E. cucumeris*, basal impression very feeble. Elytra with the striæ on the disc hardly impressed, punctures finer than in *E. cucumeris*, interstices on the disc flat, at the sides narrower and convex. Length 1–1.25 mm.; .04–.05 inch.

Ft. Capron and Enterprise, seven specimens; occurs also in Ohio. Allied to *E. cucumeris*, and of the same color and with the thorax also shining, but smaller, much shorter, and with the basal impression of the thorax much less evident.

27. **Chætocnema crenulata,** n. sp.—Broadly-oval, very convex, but little narrowed in front, elytra strongly and suddenly declivous behind, broadly rounded at apex; head and thorax sub-opaque, dark brassy, elytra shining, dark æneous; beneath black, antennæ and tibiæ testaceous, femora black. Head very little prominent, almost vertical, flat in front, very wide between the eyes, ocular sulci connected by a strongly curved line; not pubescent in front, finely alutaceous, impunctate; eyes large, moderately convex, touching the thorax; antennæ slender, last joint infuscate at tip, labrum shining, impunctate, denticulate in front. Thorax twice as wide as long in the middle, at apex produced in the middle and slightly sinuate behind the eyes, at the sides almost straight, strongly margined, base broadly rounded, finely margined; front angles rectangular, hind angles obtuse, rounded at tip; surface alutaceous, strongly, sparsely and unequally punctured. Scutellum shining, impunctate. Elytra regularly, coarsely punctate-striate, striæ hardly impressed on the disc, scutellar stria not reaching the middle, interstices sub-convex on the disc, convex at the sides, finely and obsoletely punctulate. Pleuræ of thorax and prosternum smooth, shining, the latter not margined between the coxæ; mesoternum not visible, metasternum short, smooth, shining, strongly narrowed each side and emarginated by the middle and hind coxæ, anteriorly margined by a row of coarse punctures, posteriorly each side with an impressed, feebly punctured line, lateral marginal line impunctate, medial line very fine, side pieces opaque, impunctate. First and second ventral segment shining, sparsely punctate, the remaining segments less shining, alutaceous, punctulate. Posterior femora strongly incrassate.

Crotch, Proc. Acad. Nat. Sc. Phila., 1873, 74.

Sumter County, four specimens. Distinct by the form of the body, and by the characters of the underside mentioned above.

28. **Chætocnema quadricollis,** n. sp. — Ovate, less convex, shining, above æneous, head and thorax often brassy; antennæ and legs bright testaceous-red, hind femora more or less infuscate. Head prominent oblique, deeply transversely impressed in front, not very wide between the eyes, ocular sulci connected by a transverse impression, which is foveiform in the middle; very finely alutaceous with a few scattered punctures; eyes smaller, convex, labrum with a transverse row of punctures in front; antennæ slender, last joint infuscate at tip. Thorax large, less convex, twice as wide as long, a little wider in front than at base, on the sides slightly rounded and distinctly margined, base rounded, finely margined; front angles moderately deflexed, thickened, hind angles distinct, obtuse; surface more or less distinctly alutaceous, sparsely punctulate. Scutellum small, shining, impunctate. Elytra at base evidently wider than the thorax, not acuminate at apex, regularly, moderately coarsely punctate-

striate, scutellar stria not reaching the middle, interstices smooth, subconvex. Beneath, black; epipleuræ of thorax shining, impunctate, prosternum coarsely punctate, sometimes with a smooth space in the middle, margined between the front coxæ, mesosternum visible, declivous, metasternum moderately long, smooth, shining, hind margin almost straight and not emarginated by the hind coxæ, marginal line feebly punctulate in front, simple behind and at the sides, side pieces opaque, abdomen often alutaceous, first and second segment shining, sparsely punctate, the remaining segments less shining, punctulate. Hind femora moderately incrassate, more or less infuscate, sometimes entirely testaceous. Length 1.50–1.75 mm.; .06—.075 inch.

Enterprise and New Smyrna, many specimens, in May and June. This species has exactly the aspect of a small *Crepidodera* and is distinguished by its less convex form, by the quadrate thorax, which is much narrower at the base than the elytra, and by the form of the metasternum. The sculpture of head and thorax is subject to variations as in the other species; but the form and sculpture of the sterna appear to offer more reliable characters.

29. **Microrhopala floridana,** n. sp.—Elongate, parallel at the sides, moderately shining, uniformly blackish-blue. Head sculptured as in *M. cyanea*, second joint of antennæ as long as wide, third joint a little longer. Thorax at base but little wider than long, narrowed in front, transversely convex, at the sides almost straight, base lobed in the middle and strongly sinuate each side, anterior angles acute, prominent, posterior angles obtuse; very coarsely punctured and in some specimens with a fine, impressed median line. Elytra with eight regular rows of very coarse punctures, alternate interstices evidently carinate. Prosternum with coarse punctures, metasternum punctate at the sides, abdomen sub-opaque, indistinctly punctulate. Length 3.75–4.5 mm.; .15–.18 inch.

Differs from *M. cyanea* by its narrower and more elongate form, less transverse thorax, and by the costate elytra. One specimen is almost pure black above.

Sumter county, many specimens, also found in Tampa and Enterprise.

30. **Strongylium anthrax,** n. sp.—Sub-opaque, deep black, and only the last joint of antennæ yellowish. Head formed as in *S. tenuicolle*, anteriorly sparsely and finely, posteriorly more strongly and densely punctulate; antennæ slender. Thorax at base a little wider than long, at the sides slightly rounded anteriorly, parallel posteriorly, base feebly sinuate each side, front angles rounded, hind angles rectangular, not densely punctulate, and not grooved, basal margin less thickened than in *S. tenuicolle*. Elytra

with eight rows of coarse punctures, the inner two striæ sub-impressed, interstices hardly convex, impunctate. Length 13.50 mm.; .54 inch.

One specimen from Enterprise; another from the same locality is in the cabinet of Dr. LeConte; lives on dead oak twigs. Of the size of *S. tenuicolle*, but less convex and easily distinguished by the sculpture of the elytra.

31. **Hymenorus dorsalis** Zimm., MS.—Elongate-oval, sub-impressed, above sub-opaque, with sparse, long, sub-erect pubescence, beneath shining, piceous-red, antennæ and legs red, elytra black, broadly red at base. Head strongly and sparsely punctate, angulated each side in front of eyes, which are larger and more approximate than in any other species before me, antennæ stout, two-thirds as long as the body, outer joints more than twice as long as wide, last joint of maxillary palpi with the apical side decidedly longer than the external. Thorax at base almost twice as wide as long, semicircular, finely margined, base feebly lobed in the middle, hind angles rectangular, moderately strongly not densely punctured. Elytra punctate striate, striæ hardly impressed with the punctures finer than those of the thorax and not closely placed, interstices flat, finely and sparsely punctulate; the red color occupies not quite one-third of the length of the elytra.

Tampa and Enterprise, two specimens, beaten from old palmetto leaves. Distinguished from the other sub-opaque species by the larger eyes, by the not dense punctuation of the thorax, by the sculpture of the elytra and by its color.

32. **Isomira valida,** n. sp.—Elongate-oval, convex, piceous, less shining, with moderately dense sericeous pubescence; antennæ, palpi, tibiæ and tarsi dark red. Head densely punctured, eyes very large, coarsely granulated, much less widely separated from each other than in *I. 4-striata*, antennæ slender, more than half the length of the body, second joint not quite half as long as the third, the latter as long as each of the following joints, last joint of maxillary palpi less broadly triangular than in *I. 4-striata*, apical side shorter than the external, inner side straight. Thorax twice as wide as long, on the sides strongly rounded, and strongly narrowed from base to apex, base slightly sinuate each side, finely margined, hind angles rectangular; densely punctate, in front of the scutellum with a short smooth, impressed median line, basal impressions feeble. Elytra at base twice as wide as the thorax, and three and a half times as long, densely, less finely punctulate, punctures forming transverse rugosities, obsoletely striate-punctate, the two inner striæ impressed behind. Epipleuræ of thorax, pro- and mesosternum densely rugosely punctulate, metasternum strongly punctured, posteriorly smooth, shining; abdomen densely, finely punctulate. Length 6.75–7.50 mm.; .27–.30 inch

Enterprise, four specimens, found in May, under old leaves.

Larger and broader than *I. quadristriata*, with the eyes much larger, the thorax wider, more arcuate on the sides, elytra denser and stronger punctate with the striæ on the disc more evident, underside less shining, more densely punctate. The elytra are in fact regularly striate-punctate, but the striæ are not impressed and the fine lines of punctures are confused by the equally strong punctuation of the interstices.

33. **Xylophilus quercicola,** n. sp.—More elongate than any other species before me, having the appearance of a small *Anthicus*. Head, with the eyes, a little wider than the thorax, convex behind, piceous, finely, not densely pubescent, minutely and sparsely punctulate, eyes widely separated, not oblique, antennæ red, longer than head and thorax, with moderately long, soft pubescence, intermediate joints longer than wide, outer joints as long as wide, penultimate joints subtransverse, terminal joint black, larger than the preceding, ovate, acuminate. Thorax as long as wide, at the sides rounded anteriorly, a little narrowed behind, base straight, hind angles obtuse, disc moderately convex with an obsolete impression each side in the middle, without basal impression ; sub-opaque, finely pubescent, minutely, sparsely punctulate ; color variable, testaceous at base, more or less black in front, or entirely testaceous. Elytra at base almost twice as wide as the thorax, elongate, parallel on the sides ; on the disc anteriorly depressed, sub-opaque, alutaceous, moderately strongly, not densely punctate, smooth at apex ; whitish pubescent, testaceous, an indefinite circum scutellar spot, a large spot each side behind the middle, the apex and sometimes the side margins black, the black color of the apex ascends along the suture. The pubescence is sparse on the black and dense on the testaceous parts. Beneath rufous, pubescent, sub-opaque, punctate, abdomen often blackish, impunctate ; legs testaceous. Length 1.75 mm.; .07 inch.

Tampa, seven specimens, on oak shrubs, in April. I do not perceive any sexual characters.

34. **Xylophilus ptinoides,** n. sp.—Piceous, sub-opaque, sparsely pubescent. Head, with the eyes, wider than the thorax, immersed in the thorax almost as far as the eyes. neck and hind margin of head, therefore, not visible ; front but little convex transversely ; finely and densely punctulate, eyes large, oblique ; antennæ slender, two-thirds as long as the body, with long, stiff pubescence, pale yellow, third and fourth joint more than twice as long as wide, the outer joints still longer ; last joint as long, and a little wider than the preceding, obtusely rounded at tip, infuscate. Thorax as long as wide, quadrate, very convex transversely, not rounded on the sides, front margin straight, base rounded, opaque, densely and finely punctured ; sparsely whitish pubescent, the margins and lateral vitta each side more densely pubescent, upper surface uneven with some shallow

indefinite impressions, with no distinct basal impression; color piceous, base and apex reddish. Elytra oblong, at base twice as wide as the thorax, parallel at the sides, somewhat shining, coarser and less densely punctured than the thorax; near the base with a reddish, angulated, whitish, pubescent fascia, near the apex with several other whitish pubescent spots, which form two interrupted fasciæ. Beneath piceous; sterna opaque, finely pubescent, densely punctulate; abdomen glabrous, shining, at base coarsely, at tip finely punctulate. Front legs and all the tibiæ pale, intermediate femora infuscate at base, hind femora piceous. Length 1.5 mm.; .06 inch.

Enterprise and New Smyrna, two specimens, in which I do not see sexual characters. This species has the appearance of a small *Ptinus*, and is distinguished at once from all species, except the *X. ventricosus* Lec., by the form of the head. The latter species has the head still more immersed in the thorax, the eyes touching the front margin of the thorax, but is otherwise quite distinct from *X. ptinoides*.

35. **Glipa hieroglyphica**, n. sp.—Elongate, cuneiform, black, head anteriorly densely covered with yellowish cinereous pubescence, posteriorly more sparsely pubescent, hind margin fringed with cinereous pubescence; antennæ from the fourth joint broadly serrate; maxillary palpi testaceous, upper edge black, last joint very broadly securiform, flat, apical edge not hollowed out. Thorax transverse, at apex produced in the middle, basal lobe rounded; densely punctulate, cinereo-pubescent, with the usual black spots. Scutellum rounded triangular, densely whitish pubescent. Elytra opaque, densely punctured, grayish pubescent; each with a narrowed angulated line, which begins at the scutellum and ends at the side margin a little before the middle, resembling rudely the figure 5 on the left, and on the right elytron the same figure reversed, and with a narrow oblique fascia at the apical third, cinero-pubescent. Beneath densely cinereo-pubescent; anterior femora pale testaceous, black at tip, anal style long, carinate above, at the tip emarginate, and densely cinereo-pubescent, fifth ventral segment longitudinally excavated. Length 10.5–11.25 mm.; .42–.45 inch.

Enterprise, four specimens in May. In one specimen the penultimate joint of the maxillary palpi is fringed internally with dense whitish pubescence; this is probably the ♂. I have not been able to compare this species with *G. hilaris*, which, according to the description given by Dr. LeConte (Proc. Ac. Nat. Sc., Phil., 1862, p. 46), has the last joint of the maxillary palpi hollowed out, and which has different markings on the elytra.*

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* In four specimens of *G. hilaris* examined the 5th ventral segment is not longitudinally impressed. Lec.

Additional Descriptions of New Species.

By John L. LeConte, M. D.

1. **Dyschirius falciger,** n. sp.—Rather slender, black, very shining, with a slight brown-metallic tinge; palpi, antennæ and legs ferruginous. Head smooth, convex, with the frontal and tranverse impressions deep; front truncate, with small, acute lateral angles. Eyes convex, prominent, as usual. Prothorax about as wide as long, rounded on the sides, narrowed in front, lateral impressed line not continued to the base. Elytra with striæ coarsely punctured at base, gradually becoming finer, obliterated at about three-fourths of the length; tip with faint traces of striæ, and a rather large, oblique impression, representing the end of the 7th stria. Front tibiæ with a small, acute tooth above the apical prolongation, which is straight and slender; apical spur very long and strongly curved. Length 3 mm.; .12 inch.

Tampa and Lake Harney; received also from Dr. Emil Brendel. This species is not as slender as *D. terminatus*, but is proportioned like *D. analis*, from which the characters given above easily distinguish it. *D. curvispinus* Putz., is described as having the apical spur of the front tibiæ curved, but it is otherwise quite distinct by the ferruginous color, and by the striæ of the elytra not obliterated towards the tip. The præscutellar puncture in this species is large, and the dorsal punctures usually seen on the 3d interspace are not apparent.

2. **Onota trivittata,** n. sp.—Elongate, depressed; bright rufo-testaceous, shining. Head narrowed and rounded behind the eyes, flat, without impressions; edges larger and more prominent than usual. Prothorax not as wide as the head with the eyes, longer than wide, narrowed behind, sides rounded in front, then sinuate to the basal angles which are not rounded, and slightly divergent; side margin reflexed, not very narrow, dorsal line fine, basal impressions small. Elytra wider than the prothorax, oblong, truncate at base, somewhat obliquely, broadly truncate at tip, flat, side margin reflexed, striæ composed of very fine punctures; ornamented with a common sutural black stripe, and a sub-marginal one, which extends along the apical truncature to meet the sutural one; the latter extends to the 2d stria, and behind the middle is slightly dilated for one-fourth the length to reach the 4th stria. Beneath uniform rufo-testaceous. Length 5 mm.; .20 inch.

Florida, collected by Mr. A. Bolter, of Chicago, to whom

I am indebted for two specimens. This beautiful species is easily recognized by the peculiar coloration. I have referred it to *Onota* Chaud.. because the 4th joint of the tarsi is broad, and deeply bilobed, and the claws are pectinate. The teeth of the claws are only four in number, and are much larger than in the other species. The tarsi are glabrous on the upper surface. The last joint of the maxillary palpi is cylindrical, slightly oval, and more than twice as long as the penultimate joint; the last joint of the labial palpi is oval, pointed and somewhat flattened.. Mentum not toothed. It is by this last character that it mainly differs from *Callida*, with which it agrees in having *two* bristles near the tip of the ligula.

3. **Platynus floridanus,** n. sp.—Dark green, shining, slightly bronzed, antennæ, legs and under surface piceous-black. Prothorax scarcely longer than wide, sides broadly rounded, and finely margined; apex emarginate, front angles slightly rounded; base broadly sub truncate, oblique towards the side angles, which are obtuse and almost rounded; basal impressions rather long, not punctured; dorsal line extending to the posterior transverse impression, which is faint. Elytra one-third wider than the prothorax, emarginate at base, obsoletely sinuate at tip; striæ fine, but well impressed, not punctured; interspaces flat, 3d with usually 6 small dorsal punctures, the 1st and 2d adjacent to the 3d stria, 3d and 5th upon the interspace, 4th and 6th adjacent to the 2d stria. Hind tarsi with the 1st, 2d, and 3d joints broadly grooved on the outer side. Length 9.6 mm.; .35 inch.

Capron and Lake Harney, abundant. This species is closely related to *P. californicus*, and differs only by the hind angles of the prothorax being much less distinctly defined; in fact, almost rounded. The size is usually larger, so that the smallest individuals of *P. floridanus* are equal to the largest of *californicus*, but this is a character of small importance. Closely allied to these two is the following:

4. **Platynus texanus,** n. sp.—Less shining, with a green-metallic reflection. Antennæ black; under part of 1st joint, palpi and legs testaceous; knees, tarsi and tips of tibiæ blackish-piceous. Prothorax, as in *P. floridanus*, except that it is a little wider than long. Elytra similarly striate and punctured, but with the striæ a little deeper; epipleuræ testaceous, under surface black. Groove of the outer side of the hind tarsi on the joints 1–3 deep Length 9–10 mm.; .35–.40 inch.

Abundant in Texas. For a good set I am indebted to Mr. G. W. Belfrage, of Clifton, Bosque county.

Several new species of *Loxandrus* were collected in Florida by Messrs. Schwarz and Hubbard, and full sets of previously known, but rare species were obtained. Under these circumstances, though I cannot, without reference to types contained in Baron Chaudoir's cabinet, prepare an exhaustive synopsis of the genus, the following table of the differences between the species I have examined may be found useful:

Table of Species of LOXANDRUS.

A. Side margin of prothorax explanate and reflexed towards the hind angles, which are entirely rounded into the base and sides; antennæ and palpi rufo-piceous, legs dark: (species large and middle sized).

B. Side margin of prothorax not explanate towards the hind angles, which are not rectangular: (species large and small).

C. Side margin of prothorax not explanate towards the hind angles, which are rectangular: (species small).

A.

Large species (length 13.3–10 mm.; .52–.40 inch)....................**2.**

Smaller species, with hind angles of prothorax less broadly rounded (length 10–7.8 mm.; .40–.31 inch)....................**3.**

2. Side margin of prothorax broader and more distinctly reflexed towards the base; elytra with more finely punctulate striæ, iridescent reflections less brilliant....................**1. reflexus**, n. sp.

Side margin of prothorax less definitely limited towards the base; elytra with less finely punctured striæ; iridescent reflections very bright....................**2. saphyrinus.**

3. Prothorax regularly narrowed from base to tip, sides feebly explanate towards the base....................**3. calathinus**, n. sp.

Prothorax but slightly narrowed in front; sides more distinctly explanate towards the base....................**4. floridanus**, n. sp.

B.

Larger species (length 13–9.3 mm.; .50–.37 inch)....................**2.**

Small species (length 7.7–5.8 mm.; .32–.225 inch)....................**4.**

2. Legs dark....................**3.**

Legs ferruginous, prothorax wider than long, hind angles obtuse, blunt or rounded at tip....................**5. rectus.**

3. Prothorax wider than long, hind angles slightly obtuse, not at all rounded....................**6. brevicollis.**

Prothorax very slightly wider than long, hind angles rounded at the extreme tip....................**7. minor.**

Proth. not wider than long, hind angles not rounded......**8. erraticus.**

4. Legs dark, hind angles of prothorax not rounded; elytra with a round sutural red spot behind the middle........................**9. celer**.

Legs dark, hind angles of prothorax rounded at tip; varies with the legs brown-ferruginous, seems to pass insensibly to *L. velox*..**10. agilis**.

Legs yellow, hind angles of prothorax rounded at tip........**11. velox**.

α. Prothorax rounded on the sides; not conspicuously wider than long, *velox*.

β. Prothorax rounded on the sides, conspicuously wider than long; *pusillus*.

γ. Prothorax nearly square, less rounded on the sides; *tæniatus, piciventris*.

C.

Legs dark, elytral striæ feebly punctured.,......**12. rectangulus**, n. sp.

Legs yellow, elytral striæ coarsely punctured.............**13. crenatus**.

5. **Loxandrus reflexus**, n. sp.—Black, very shining, with iridescent reflection. Prothorax wider than long, feebly emarginate at apex, equally feebly rounded at base, sides and hind angles rounded; side margin reflexed, narrow in front, becoming much wider behind, so as to extend at the base to the basal impressions, which are linear and deep; dorsal line very fine, transverse impressions obsolete. Elytra not wider than the prothorax, striæ finely punctured in front, deeper and not punctured behind, antennæ, palpi and tarsi piceous-brown. Length 10–13 mm.; .40–.50 inch.

Tampa, not rare. This fine species has much resemblance to *L. saphyrinus*, which occurs in Louisiana; but on comparison, the iridescent reflection is less vivid, the prothorax is less rounded on the sides, the broad part of the reflexed side margin towards the base is much better defined, and finally the elytral striæ are much more finely punctured from the base to the middle.

6. **Loxandrus calathinus**, n. sp.—Elongate-oval, black, very shining, slightly iridescent; tarsi and antennæ piceous, the latter with joints 1–3d, and palpi dark ferruginous. Prothorax wider than long, much narrower in front than behind, broadly rounded on the sides, which are broadly but not strongly explanate towards the base; hind angles distinctly rounded at tip, basal impressions linear, as usual deep. Elytra with the striæ finely but distinctly punctured. Length 8.8–10 mm.; .35–.40 inch.

Tampa, Florida; not common.

7. **Loxandrus floridanus**, n. sp.—Black, very shining, iridescent; antennæ and legs piceous or blackish, base of the former, palpi and tarsi ferruginous. Prothorax wider than long, scarcely narrower in front than at base, sides rounded, broadly but slightly explanate towards the base; hind angles obtuse and more rounded at the tip than in *L. calathinus*,

basal impressions linear, not very deep. Elytra with the striæ feebly and finely punctulate. Length 7.4–8.5 mm.; .29–.33 inch.

Capron and Enterprise; abundant. Varies in color according to maturity, so that the tibiæ and sides of the thighs also become yellow-brown. In some specimens the sides of the prothorax are less distinctly explanate, and such, except by their larger size, are difficult to distinguish from *L. agilis.*

8. **Loxandrus rectangulus,** n. sp.—Black, very shining; slightly iridescent; antennæ and legs piceous, or blackish. Prothorax wider than long, slightly narrower at tip than at base, sides rounded, not sinuate behind, hind angles rectangular, not at all rounded; side margin more broadly reflexed towards the base, sides not explanate; base with a few scattered punctures, impressions linear, deep. Elytra distinctly wider than the prothorax, striæ not punctured. Length 6.5 mm.; .25 inch.

Enterprise, May; rare. This species and *crenatus*, by hav-the elytra wider than the prothorax resemble in form certain Platyni and Bembidia. There are but two specimens before me; in the ♀ the elytral striæ are much deeper than in the ♂.

9. **Selenophorus excisus,** n. sp.—Oblong, æneous, sub-depressed; legs and antennæ piceous, first joint of antennæ ferruginous. Prothorax nearly twice as wide as long, rounded on the sides, which are finely margined, a little narrower at base than at tip; hind angles rounded, basal impressions shallow, not punctured. Elytra deeply sinuate at tip; humeri rounded, striæ fine, interspaces flat; punctures of the three series rather large and conspicuous. Hind tarsi long and slender, Length 5.5 mm.; .22 inch.

Southern Florida, Dr. Palmer, 3 specimens. Of the same size, form and characters as *S. fatuus*, from which it differs by the punctures of the three elytral series being much larger, and by the hind angles of the prothorax more obtuse and more rounded. The outer interspaces of the elytra are not all punctulate.

10. **Hydroporus seminulum,** n. sp.—Broadly ovate, obliquely attenuate behind, rounded in front, not very convex; rufo-testaceous, shining. Prothorax scarcely perceptibly punctulate, with a fine short basal stria each side, which does not extend upon the elytra; the latter very finely, though distinctly punctulate. Beneath sparsely but strongly punctured. Length 1.3 mm.; .05 inch.

Enterprise, one specimen. Of the same size as *H. granum*, but very different by the body being strongly narrowed behind the middle, and pointed at the posterior end. Differs also from all previously known small species of the United States, by the thorax having a very short basal stria not continued on the elytra.

11. **Dineutes angustus,** n. sp.—Narrower, smaller and more convex than *D. discolor*, elongate-oval, slightly narrowed in front, bluish-black, with slight metallic gloss. Prothorax very little wider than the head, sides straight, slightly oblique, transversely very convex. Elytra sparsely, finely punctured, striæ obliterated; sides feebly and narrowly explanate, scarcely undulated near the apex, which is (♀) obtusely prolonged. Under surface and legs rufo-testaceous. Length 9.5 mm.; .375 inch; breadth 4.5 mm.; .175 inch.

Three females, collected by Dr. Palmer. The marginal line of the front margin of the prothorax is less interrupted in these specimens than in *D. discolor*, but I do not think this a character of any value.

Table of Species of OCHTHEBIUS.

The number of species of *Ochthebius* in our fauna has increased to such an extent, that the recognition of the three new species collected by Mr. Schwarz would be facilitated by the description of those from other parts of the country. The following table contains those which I have been able to examine:

Prothorax much wider than long, strongly rounded on the sides, disc strongly punctured and deeply channeled..........................2.
Prothorax much wider than long, disc lobed at the sides, discoidal impressions foveate, dorsal channel deep..............................5.
Prothorax sub-quadrate, less rounded on the sides..................8.
2. Prothorax with deep discoidal impressions each side of dorsal channel; pellucid margin suddenly dilated inwards at the base..............3.
Prothorax with discoidal impressions faint or wanting; pellucid margin slightly wider towards the base..................................4.
3. Discoidal impressions united, forming a groove each side of the dorsal channel, sides of disc of prothorax curved............**1. puncticollis.**
Discoidal impressions separate, sides of disc of prothorax curved....... **2. discretus,** n. sp.
Discoidal impressions separate, sides of disc of prothorax straight...... **3. rectus,** n. sp.
4. Lateral impressions large and broad, discoidal ones wanting........... **4. cribricollis.**
Lateral impressions smaller, discoidal small, faint....**5. attritus,** n. sp.
Lateral impressions small, discoidal wanting.........**6. simplex,** n. sp.

5. Prothorax shining, elytral striæ usually composed of distant punctures.**6.**
Prothorax less shining, elytral striæ of small, less distant punctures..**7.**
6. Elytra with striæ of small, close-set punctures, not effaced behind......
7. tuberculatus, n. sp.
Elytra with striæ of large, distant punctures, effaced behind.**8. nitidus.**
Elytra more convex and more oval, striæ effaced..**9. lævipennis**, n. sp.
7. Disc of prothorax lobed behind the front angles...**10. foveicollis**, n. sp.
Disc of prothorax not lobed behind the front angles..................
11. benefossus, n. sp.
8. Prothorax with dorsal channel fine, interrupted, or obsolete..........**9.**
Prothorax with dorsal channel deep, entire........................**10.**
9. Discoidal impressions of prothorax forming sinuate lines; dorsal line interrupted....................................**12. sculptus**, n. sp.
Discoidal impressions vague, connected transversely; dorsal line obsolete...**13. Holmbergi.**
Discoidal impressions forming fine, sinuate lines; dorsal line fine, abbreviated at each end...............................**14. lineatus.**
10. Discoidal impressions deep, not confluent, prothorax more transverse, and feebly punctured (reverts towards No. 4)........**15. interruptus.**

12. **Ochthebius discretus**, n. sp.—Dull brownish-bronze, elongate-oval, moderately convex; head with strongly impressed frontal suture; front sparsely, hind part coarsely punctured, with two large foveæ, and a small posterior impression. Prothorax twice as wide as long, much rounded on the sides, pellucid margin very narrow, dilated inwards at base; disc greenish-bronze, strongly punctured, deeply channeled, with two deep, oblong impressions each side, and another half way to the lateral margin. Elytra but slightly wider than the prothorax, striæ deep, closely punctured, fainter and nearly obliterated at tip. Legs and under surface dull testaceous. Length 2 mm.; .075 inch.

California, San Mateo, Gilroy and San Diego; Mr. G. R. Crotch; Dr. Horn has received a smaller specimen from Canada. Resembles *O. puncticollis*, but is smaller and less robust, and the outer dorsal lines are interrupted so as to form two deep impressions.

13. **Ochthebius rectus**, n. sp.—Oval, convex, dark bronzed, not very shining. Prothorax twice as wide as long, pellucid margin rather broad, rounded on the sides, suddenly dilated inwards near the base; disc with the outline straight from the front angles to the posterior deep emargination; convex, deeply and coarsely punctured; dorsal line deep, discoidal impressions deep, nearly united, lateral impressions large, deep. Elytra with striæ of large and deep quadrate punctures. Legs dark-testaceous. Length 14 mm.; .06 inch.

Fort Tejon, Cal.; Mr. Crotch, one specimen. Related to

O. discretus, but very different by the sides of the disc of the prothorax being quite straight for nearly two-thirds the length.

14. **Ochthebius attritus,** n. sp.—Elongate-oval, bronzed. Head sparsely but strongly punctured, with two occipital foveæ, and deep frontal suture. Prothorax wider than long, narrowed behind, pellucid margin very narrow, visible only behind the middle; disc strongly punctured, not lobed at the sides, dorsal channel deep, discoidal impressions small, separate, lateral impression broad, shallow. Elytra less shining, striæ composed of nearly square, close-set punctures, not obliterated at the tip. Beneath blackish, legs testaceous. Length 1.5 mm.; .06 inch.

Haulover, March, one specimen. Related to *O. cribricollis*, but much narrower and smaller, and with distinct, though not deep, discoidal impressions.

15. **Ochthebius simplex,** n. sp.—Oval, more convex, bronzed, less shining. Head sparsely, strongly punctured, with two occipital foveæ, and deep frontal suture. Prothorax wider than long, slightly narrowed behind, pellucid margin very narrow, visible behind the middle; disc strongly punctured, not lobed at the sides, dorsal channel deep, discoidal impressions scarcely visible; lateral impressions nearly obsolete; a small, shallow fovea is seen near the hind angle. Elytra with rows of close-set, not very fine punctures, not obliterated behind. Legs testaceous. Length 1.2 mm.; .048 inch.

Haulover, March, one specimen. Very much smaller and more convex than *O. cribricollis*, with the lateral impressions small and indistinct.

16. **Ochthebius tuberculatus,** n. sp.—Longer and less convex than *A. nitidus*, piceous-bronze, shining. Head with two large foveæ, and deep, transverse suture. Prothorax wider than long, sides moderately rounded, pellucid margin represented only by a small lateral spot, and one at the hind angles; disc not punctured, dorsal channel very deep, discoidal impressions very deep; each side a small, round fovea in front of the middle, a longer slightly oblique one behind the middle, and another one near the side, which is strongly lobed; the prolongations of the disc to the anterior angles are very convex, forming a large tubercle. Elytra with striæ composed of small, close-set punctures. Beneath piceo-testaceous. Length 1.5 mm.; .06 inch.

Moqui villages, New Mexico, Dr. Horn.

Ochthebius nitidus *Lec.*, Agassiz, Lake Superior, 217; *O. fossatus* Lec. Proc. Acad. Nat. Sc. Phila. 1855, 362.

Lake Superior; Fort Yuma, Cal. The synonym belongs to a specimen which differs only by the punctures of the elytral striæ being less distant. Allied to this, but apparently distinct is:

17. **Ochthebius lævipennis,** n. sp.—Dark piceous-bronze, very convex, shining, of the same form as *O. nitidus*. Head with two large deep foveæ, and a deep transverse suture. Prothorax with deep dorsal line, two small foveæ each side in front of the middle, a deep impression near the apical margin, towards the anterior angle; sides deeply lobed as in *O. nitidus*, pellucid margin broad, with an undulated outline. Elytra with deep, humeral fossæ; striæ obsolete, traced only by a few fine, distant punctures near the base. Under surface piceous, legs testaceous. Length 1.3 mm.; .05 inch.

Tejon, California; one specimen, Dr. Horn. It is possible that this is an extreme variety of *O. nitidus*, but until the intermediate forms are collected, it should properly be known under a different name.

18. **Ochthebius foveicollis,** n. sp.—Closely resembles *O. nitidus*, but the elytra are longer, more obliquely narrowed behind, and the striæ are composed of rather large, close-set punctures, not less distinct towards the tip. From *O. tuberculatus*, it differs by broader prothorax, with larger lateral pellucid spot, and broader anterior lobes of the disc. Length 1.2 mm.; .048 inch.

Enterprise and Lake Harney, Florida, May; not rare.

19. **Ochthebius benefossus,** n. sp.—Oval, moderately convex, bronzed, shining. Head sparsely punctured, with two very large foveæ connected behind; transverse suture deep. Prothorax wider than long (pellucid margin?) disc with the sides straight from the anterior angles to the middle, then strongly narrowed to the base (making a concave outline which must be filled with membrane in well preserved specimens); sparsely punctured, dorsal channel very deep, discoidal impressions deep, the posterior ones connected in a horse shoe form. Elytra with striæ composed of punctures distant from each other about their own diameters, basal fossæ small. Beneath piceous, legs testaceous. Length 1.5 mm.; .06 inch.

New Jersey, Dr. Horn. Nearly of the same form as *O. nitidus*, but different by the disc of the prothorax not being lobed at the side behind the front angles, as well as by the style of sculpture, which is more simple, and tends towards *O. Holmbergi* and allies.

20. **Ochthebius sculptus,** n. sp.—Elongate-oval, greenish-piceous, slightly bronzed, shining. Head sparsely punctured with deep frontal su-

ture, and three occipital foveæ of equal size. Prothorax broader than long, distinctly narrowed behind; pellucid margin rounded, dilated inwards towards the base; disc feebly lobed at the sides; feebly punctulate at the middle, more distinctly towards the sides; with two vague transverse impressions, one before, the other behind the middle; dorsal line interrupted, sometimes obsolete, discoidal lines sinuate, well marked; lateral impression large. Elytra with rows of fine, close-set punctures, not effaced towards the tip. Legs dark testaceous. Length 1.5 mm.; .06 inch.

Gilroy, California, Mr. Crotch; Arizona, Dr. Horn. A nearly similar specimen from Canada is also in his collection; it is rather stouter in form, and the prothorax is more narrowed behind, but I am unwilling without a larger series of specimens to consider it distinct.

RHINOSCEPSIS n. g. (PSELAPHIDÆ.)

Head sub-pentagonal, a little longer than wide, sides parallel behind the eyes, base truncate, hind angles rectangular, rounded at tip. Antennæ inserted under a narrow frontal protuberance (which projects over the mouth, somewhat like the prothoracic horn of *Notoxus*), 1st and 2d joints thick, the former nearly twice as long; 3d–8th small, rounded; 9th rounded, a little larger; 10th slightly wider; 11th ovate, acute at tip, longer than the three preceding united. Maxillary palpi as long as the head, slender, last joint ovate acute, similar in form to the last joint of the antennæ. Prothorax pentagonal, not convex, with a deep sub-interrupted dorsal channel, and a transverse impression behind the middle. Elytra not convex, with a deep sutural stria, a fine dorsal one near the sutural, a sub-apical fovea near the sides, and a marginal stria nearly as deep as the sutural. Dorsal surface of abdomen broadly margined, segments 1–3d equal in length. Tarsi with a single claw.

♂. Penultimate ventral segment strongly and broadly emarginate, last segment longitudinally impressed; front tibiæ much thicker at the middle, gradually attenuated at base and tip.

♀. Last ventral segment large, semi-circularly impressed in front, with a few long hairs intermixed.

21. **R. bistriatus,** n. sp.—Brown, sub-depressed, not shining, finely pubescent. Head with two occipital foveæ and an elongate, but not deep frontal impression; eyes very small, rounded; prothorax scarcely wider than long, dorsal channel deepest at the intersection with the transverse impression. Elytra with sutural, and marginal striæ very deep, a fine dorsal stria near the sutural, and sub-apical fovea near the marginal stria; surface finely punctulate; wider than the prothorax, gradually broader from the base almost to the apical truncature. Abdomen a little longer than the elytra, finely punctulate. Length 1 mm.; .041 inch.

Enterprise and Tampa. This genus exhibits an odd mixture of characters. It resembles in form and sculpture the new species of *Rhexius* described below, and has also the appearance of *Trichonyx*, but it differs from those genera by the insertion of the antennæ, which are approximate, and situate under the frontal protuberance, which is longer than in any other genus yet known as belonging to our fauna. It resembles, so far as I can judge by the figure and description, the Grecian genus *Panaphantus* Kiesenw. Berl. Ent. Zeitschr. ii, 49, pl. 3, f. iv.

22. **Rhexius substriatus,** n. sp.—Larger, darker and less convex than *R. insculptus*. Head with two foveæ and a frontal impression ; occiput very finely carinate ; eyes small. Prothorax finely channeled, with three large impressions near the base. Elytra with basal margin elevated, post-basal foveæ deep, each with four faint striæ, of which the sub-sutural one is longer and more distinct, the others extending only to about the middle. Antennæ with the 9th and 10th joint less suddenly larger than in *R. insculptus*. Length 1.5 mm ; .06 inch.

Tampa, April, one specimen, under old leaves.

23. **Trimium convexulum,** n. sp.—Pale rufo-testaceous, shining, slightly pubescent. Head with a large deep angulated impression, front concave, occiput convex, smooth. Prothorax longer than wide, convex, subcordate, rounded on the sides in front, then narrower and broadly sinuate; disc smooth, with a transverse impression near the base ; this impression is slightly angulated at the middle, and extends on the sides, but does not terminate in a lateral fovea, as is the case in *T. parvulum*. Elytra convex, deeply bifoveate at base, sutural stria faint, dorsal one short. Length 7 mm.; .028 inch.

Tampa, May, one specimen. I have one quite similar from Illinois. Mr. Ulke has received specimens from Tennessee.

34. **Trimium californicum,** n. sp.—Allied to *T. globiferum*, but larger and stouter, bright red-brown. Head with an angulated impression ending behind in two large foveæ ; occiput convex, smooth. Prothorax rather wider than long, not very convex, narrower behind ; foveæ large, connected by a deep transverse line. Elytra nearly twice as wide as the prothorax, sparsely punctulate ; basal foveæ small, sutural stria deep, dorsal fine, extending for two-thirds the length of the elytra. Antennæ with the last joint ovate, acute at tip, not so large as in *T. globiferum*. Length 1.3 mm.; .05 inch.

California, a specimen kindly given me by Dr. Horn.

The largest of our species and easily recognized. *T. clavicorne* Mäklin, may possibly be this, but the description is not sufficiently definite to permit its identification.

25. **Trimium puncticolle,** n. sp.—Elongate, red-brown; head with an angulated line, ending behind; in small foveæ; occiput broadly convex, not impressed. Prothorax convex, longer than wide, rounded on the sides in front, narrower behind; foveæ large, connecting line deep, disc finely and distinctly punctured. Elytra oblong-ovate, wider behind; basal foveæ large, sutural stria deep, dorsal stria short. Length .9 mm. .035 inch.

Arizona; many specimens were found in an ant's nest by Dr. Horn.

26. **Trimium simplex,** n. sp.—Very small, pale, rufo-testaceous, less shining, finely pubescent. Head with a deep, angulated impression, ending each side behind in a large fovea. Prothorax convex, longer than wide, with a large basal fovea on the declivity of the side, connecting transverse line obsolete. Elytra not very convex, bifoveate at base, sutural stria distinct, dorsal stria very short. Length .5 mm.; .02 inch.

Tampa, one specimen. This is the smallest Pselaphide known to me, being smaller even than *T. americanum.*

Four other species of *Trimium* in my collection, though not belonging to this zoölogical district may here be conveniently described.

27. **Trimium discolor,** n. sp.—Elongate, chestnut-brown, slightly pubescent, abdomen darker. Head with two small foveæ, and an arcuated frontal impression; vertex slightly punctulate, convex, faintly channeled or foveate behind. Prothorax longer than wide, convex, with a deep, angulated impression near the base, which terminates in a small, lateral fovea upon the deflexed part of the sides. Elytra bifoveate at base, outer fovea deeper than in the other species, sutural stria fine, dorsal one short. Antennæ and legs ferruginous. Palpi short, a little longer than the 1st and 2d joints of the antennæ: the 9th and 10th joints of the latter are transverse. Length .9 mm.; .035 inch.

One specimen, Louisiana. I have adopted the name proposed by Dr. Zimmermann.

28. **Trimium foveicolle,** n. sp.—Elongate, bright rufo-testaceous, very slightly pubescent. Head convex, smooth, with a fovea each side above the eyes, and a transverse angulated frontal impressed line. Prothorax longer than wide, convex, with three sub-basal foveæ, connected by a transverse impressed line; the lateral foveæ are larger, and situated on the declivity of the sides. Elytra bifoveate at base, sutural stria deep, dorsal one short. Antennæ with 9th and 10th joints transverse. Length .9 mm.; .035 inch.

Cambridge, Massachusetts; Mus. of Comp. Zoölogy; one specimen, collected in December, by Mr. H. G. Hubbard. The palpi are rather short, with the last joint ovate-pointed as in the preceding, but it differs from that, as from all the others in our fauna, by the foveæ of the head being much nearer the eyes. The eyes are more lateral and prominent, and have not a shallow groove and elevated margin above them. This margin, though not strongly marked, is seen in the other species, and separates the upper surface of the cranium from the sides.

Table of species of TRIMIUM.

Eyes far down on the sides of the head, with a shallow groove, and slightly elevated margin above them; foveæ on upper surface distant from the eyes..**2.**
Eyes lateral, more prominent, foveæ not distant from them; thoracic foveæ deep, connected as usual by a transverse line.............. **1. foveicolle**, n. sp.
2. Prothorax less convex, wider than long............................**3.**
Prothorax more convex, longer than wide..........................**4.**
3. Head with deep arcuated impressions ending behind in large foveæ, front suddenly declivous; elytra deeply foveate at base, dorsal stria short...**2. globiferum.**
Head with the anterior part of impression effaced or less deep, front obliquely declivous; elytra with small basal foveæ, dorsal stria fine, half the length of the elytra..........................**3. impunctatum.**
Head with an angulated impression ending behind in large foveæ; elytra with small basal foveæ, dorsal stria fine, two-thirds the length of the elytra.............................**4. californicum**, n. sp.
4. Lateral foveæ of prothorax large, connecting transverse line deep....**5.**
Lateral foveæ small..**6.**
5. Prothorax finely and distinctly punctured; head with a large angulated impression, occiput convex, smooth; elytra deeply foveate at base, sutural stria deep, dorsal stria very short........**5. puncticolle**, n. sp.
Prothorax not punctulate, head scarcely punctulate, with an arcuate impression, and two small foveæ; occiput convex, slightly channeled; color dark chestnut.............................**6. discolor**, n. sp.
6. Elytra oblong-ovate, as usual, moderately widened from the base.....**7.**
Elytra strongly ovate, narrow at the base, gradually much wider behind..**10.**
7. Transverse line of prothorax very deep...........................**8.**
Transverse line of prothorax faint...............................**9.**
8. Head scarcely punctulate, foveæ large, frontal impression a fine trans-

verse line ; occiput less convex, slightly impressed at the middle ; prothorax less elongate, more rounded on the sides.........7. **parvulum.**

Head smooth, with an angulated impression ending behind in foveæ ; occiput convex, finely carinate................8. **convexulum,** n. sp.

9. Head smooth, with a deep angulated impression, ending behind in foveæ ; occiput convex not impressed. Size very small...........
9. **simplex,** n. sp.

10. Head very distinctly punctulate, foveæ and impression broad not deep ; occiput not channeled ; (color pale rufo-testaceous)......10. **dubium.**

Head smooth, with a deep angulated impression ending behind in foveæ ; occiput with a shallow fovea ; transverse line of prothorax very deep ; elytra very convex, sutural stria faint........ .....11. **americanum.**

NOTE.—In *T. foveicolle, globiferum, inpunctatum* and *californicum* there are two fine short impressed lines at the base of the dorsal surface of the abdomen, as in many species of *Bryaxis.*

29. **Euplectus debilis,** n. sp.—Elongate, somewhat depressed, brown ; antennæ, palpi and legs paler. Head with a deep, acutely angulate impression ending behind in two foveæ ; occiput elevated, not impressed. Prothorax with large lateral basal foveæ, an angulated posterior impression, and a deep, interrupted dorsal channel ; the basal part extending to the transverse impression, the discoidal part attaining neither the impression nor the apical margin. Elytra with deep sutural stria, and short dorsal one ; basal foveæ not large. Length .6 mm.; .026 inch.

Tampa, May, one specimen. Not larger than *E. pumilus,* but quite distinct by the more elongate and depressed form, and by the dorsal channel of the prothorax less deep, and more completely interrupted.

30. **Euplectus tenuis,** n. sp.—Elongate, less depressed, brown ; elytra darker, antennæ, palpi, and legs paler. Head with a deep, arcuated impression ending behind in foveæ ; occiput convex, very feebly impressed. Prothorax with large, lateral foveæ, and an angulated posterior impression, dorsal channel very fine, not extending to the apical margin, sub-interrupted near the transverse impression. Elytra with deep sutural stria ; dorsal stria fine, extending to the middle. Length .7 mm.; .028 inch.

Capron, May, one specimen. Nearly related to *E. debilis,* but more pubescent, with the front more convex, the impression curved rather than angulated, and the dorsal line of the prothorax finer. The following species, though not belonging to the same district, is closely allied:

36. **Euplectus integer,** n. sp.—Elongate, dark brown, slightly pubescent, antennæ, palpi, and legs paler. Head with two large foveæ, not connected by an impression ; front convex, but not prominent. Prothorax with deep lateral foveæ; posterior angulated impression deep, dorsal line wanting. Elytra with deep sutural stria, dorsal stria wanting, represented only by the small basal fovea. Length .7 mm.; .028 inch.

Detroit, Michigan, one specimen; Messrs. Hubbard and Schwarz. This species resembles in specific characters certain *Trimium* (e. g. *parvulum*, *convexulum*), but is easily recognized by the less convex body, the more broadly margined abdomen, and smaller antennal club.

32. **Euplectus cavicollis,** n. sp.—Elongate, red-brown, finely pubescent. Head with a deep curved impression, ending behind in foveæ; front prominent, occiput moderately convex, not very shining. Prothorax more dilated on the sides than usual, with three very large posterior foveæ, not connected by a transverse line; dorsal line very fine, abbreviated in front. Elytra with sutural stria deep, basal foveæ small, dorsal striæ wanting. Length 1.2 mm.; .05 inch.

Tampa, May; one specimen. Very distinct from the other species in my collection by the large, separate foveæ of the prothorax.

33. **Acylophorus densus,** n. sp.—Black, shining; head and prothorax glabrous, of the same form and sculpture as in the other species. Elytra densely, not very finely punctured, sub-opaque, clothed with fine, dark pubescence. Abdomen slightly iridescent, pubescent, punctures becoming more sparse behind; ventral segments strongly iridescent. Legs (including front coxæ) reddish-brown. Antennæ piceous, black at base, joints 3–7 longer than wide, though not entirely equal either in length or breadth; 3d joint a little shorter than the 2d. Length 5.5 mm.; .21 inch.

Enterprise, May; one specimen. Larger than what I consider as *A. pronus*, equal to *A. pratensis*, but easily known by the punctures of the elytra more dense than in either.

34. **Acylophorus flavipes,** n. sp.—Shining black above, piceous beneath; head and prothorax as usual. Elytra coarsely and not densely punctured, sparsely pubescent. Abdomen hairy, strongly, not densely punctured. Legs (including front coxæ) testaceous. Antennæ not longer than the head and prothorax, piceous black, base of 1st joint nearly testaceous; joints 3–10 equal in length, gradually increasing in thickness, and closely approximated, outer ones transverse; 2d joint fully as long as the 3d and 4th united. Length 4.5 mm.; .18 inch.

Capron, May; one specimen. Smaller and more slender than *A. pronus*, with which it agrees in sculpture, but differs in the antennæ and color of the legs.

The species of this genus resemble each other very closely, and except *A. flavicollis*, which has the prothorax yellow, are to be separated only by slight differences in the proportion of the joints of the antennæ, and the punctuation of the elytra.

Table of Species of ACYLOPHORUS.

Antennæ with 2d joint distinctly longer than 3d, nearly equal to 3d and 4th united ; prothorax more strongly narrowed in front...........2.
Antennæ with 2d joint nearly or quite as long as 3d ....3.
2. Prothorax yellow, elytra densely, strongly punctured....**1. flavicollis.**
Prothorax black, elytra less densely, but strongly punctured.**2. pronus.**
3. Antennæ with joints 3–6 longer and more slender...................4.
Antennæ with joints 3–10 equal in length ; elytra strongly, not densely punctured..................................**5. flavipes,** n. sp.
4. Elytra finely, not densely punctured.....................**3. pratensis.**
Elytra strongly and densely punctured...............**4. densus,** n. sp.

A. gilensis Lec. does not seem sufficiently distinct from *A. pronus* Er.

Mr. Fauvel (Faun. Gallo-Rhen. iii, 542) states that *A. pratensis* Lec. is the same with *A. glabricollis* of Europe. I have not compared specimens, but think that the finer punctuation of *pratensis* entitles it to distinct recognition, and that Mr. Fauvel's remark will apply better to some of the black-legged varieties of what we consider *A. pronus*.

35. **Quedius ferox,** n. sp.—Elongate, linear, black, very shining, antennæ and legs blackish or piceous. Head oval, strongly narrowed behind, and constricted at the neck, which is not slender ; sides before and behind the eyes sparsely punctured ; a series of five setigerous punctures each side above the eyes ; nearer the middle, opposite the 5th one is a 6th. Eyes not prominent, occupying the middle third of the length of the head. Prothorax longer than wide, not narrowed in front, sides straight, parallel nearly to the apex, where they are moderately rounded, slightly sinuate near the base ; apex emarginate, base rounded ; there are 3 punctures each side on the apical margin, one near the margin, and one on the disc, about one-third the length ; there is also a large, lateral puncture near the margin, in front of the middle ; three small marginal ones behind the middle, and a few on the basal margin. Elytra smooth, with obsolete sutural stria, and 3 small sub-sutural punctures ; there is also a dorsal series of 4 very small punctures. Dorsal segments slightly iridescent, rather densely punctured and pubescent, with long, lateral and apical setæ. Beneath blackish-piceous, strongly punctured, slightly iridescent. Length 8.5 mm.; .34 inch.

Enterprise, May ; also found in Louisiana, Canada and

Massachusetts. The last ventral segment in the ♂ is broadly and feebly emarginated, and the front tarsi dilated.

Another species of the same group of the genus, which has not been thus far represented in our fauna is:

36. **Quedius vernix,** n. sp.—Less elongate, narrower in front and behind; black, very shining, antennæ, palpi, and legs also black. Head oval, moderately constricted at base, neck rather thick, punctulate each side; space behind the eyes, and extending beneath to the lateral line finely punctured, sub-ocular punctures two, supra-oculars also two; each side near the anterior one is one small puncture, and behind the posterior one, on the occipital declivity is another large one. Prothorax scarcely as long as the basal width, narrowed in front, sides rounded, apex emarginate, base strongly rounded; apical punctures three on each side; discoidal but one; lateral one, large, situated near the margin, and one-fourth the length from the front angle; there are but two small basal punctures, in the margin itself, the outer one at the much rounded hind angle. Scutellum large, smooth. Elytra smooth, sutural stria deep, with a puncture in front of the middle; dorsal series of 4 or 5 large punctures. Dorsal segments very sparsely punctured and pubescent, sides and apex with long setæ; ventral segments equally, sparsely punctured. Length 12 mm.; .48 inch.

Massachusetts, Michigan, Canada, rare. The front tarsi are dilated in both sexes; the last ventral segment is longer, and scarcely perceptibly emarginate in the ♂.

37. [5]. **Cryptobium floridanum,** n. sp.—Shining, hairy, with erect pubescence, black, becoming brown towards the tip of the abdomen, antennæ brown, legs paler. Head as long as the prothorax, and wider than it, oblong, somewhat narrower in front of the eyes, which are convex and moderately prominent; base and hind angles rounded, surface strongly punctured, front nearly smooth. Prothorax one-half longer than wide, smooth dorsal stripe broad, sides strongly punctured, the punctures forming in places short irregular series. Elytra longer than the prothorax, strongly rather densely punctured. Abdomen, dorsal surface finely and sparsely punctured; ventral surface similarly punctured. Length 10.4 mm.; .41 inch.

♀ Second and third ventral segments with a short transverse groove, bearing stiff setæ.

Enterprise, May; one specimen. This species is similar in form and sculpture to *C. badium*, but the color is different, and the 3d apparent ventral segment (♀) has a transverse fold similar to that of the 2d. In *C. carolinum* the second ventral segment has (♀) a transverse fold, with a row of stiff bristles, but the 3d segment is foveate as in the ♂ of the species of that group.

The species of this genus have become so numerous in our fauna, that the following table will be found useful for their recognition:

Table of Species of CRYPTOBIUM.

Sides of head parallel, hind angles strongly rounded.................2.
Head gradually narrowed behind the eyes.........................B.
Head short and semicircularly rounded behind the eyes.............C.
2. Last joint of maxillary palpi conical, half as long as the 3d joint....A.
Last joint of maxillary palpi small, acicular, one-third as long as the 3d joint, which is more thickened at the tip................................D.
Last joint of maxillary palpi very small, not conical, one-fourth as long as the 3d joint, which is tumid, much thickened at the tip.........E.

A. ♂ 3d ventral segment foveate near the base and with a long and broad apical process, extending over the next segment, and furnished with long stiff black setæ; 2d segment with a short transverse fold at the middle; ♀ with 2d, or 2d and 3d ventral segments each with a transverse fold or fovea...2.
♂ 6th ventral segment deeply and acutely emarginate, sometimes almost to the base; ♀ ventral segments not impressed nor foveate...6.
2. Uniform chestnut brown, feet testaceous yellow....................3.
Rufo-testaceous, head and abdomen, except last two segments black, or dark...4.
Black, last ventral segments brownish, antennæ brown, legs testaceous.5.
3. ♀ 2d ventral segment with a transverse fold at the middle...**1. badium.**
♀ 2d ventral segment not impressed; head less convex and more parallel than in *C. badium*.............................**2. pimerianum.**
♀ 2d ventral segment not impressed; head with sides more gradually rounded behind; last two abdominal segments paler.**3. texanum,** n.sp.
4. ♀ with 2d ventral segment foveate; head and abdomen black, last two segments pale...**4. bicolor.**
♀ as above, head only black (immature)......... *a.* **melanocephalum.**
5. ♀ 2d and 3d ventral segments each with a short transverse fold at the middle...**5. floridanum.**
♀ 2d ventral segment with a transverse fold, 3d foveate....**6. carolinum.**
6. Black, shining, antennæ dark brown, legs testaceous................7.
Black, shining, legs and elytra bright rufous; the latter with a broad black stripe extending from the base to the middle.......**7. sellatum.**
7. Antennæ brown; punctures of prothorax finer.......................8.
Prothorax strongly punctured; antennæ brown.**8. californicum,** n.sp.
Prothorax strongly punctured; antennæ yellow..**9. flavicorne,** n. sp.
8. Sides of head parallel behind the eyes...............................9.
Head wider behind the eyes...................**12. tumidum,** n. sp.

9. Elytra not longer than prothorax..........................**10. pallipes.**
Elytra longer than thorax..............................**11. latebricola.**

B. ♂ 6th ventral segment triangularly emarginate; ♀ 2d and 3d ventral segments not impressed. Prothorax with dorsal series of punctures; sides very sparsely punctured. Elytra very coarsely punctured. Last joint of maxillary palpi conical, half as long as the 3d in *serpentinum*, smaller in *cribratum*.

Shining, black, antennæ brown, legs and elytra bright rufous; prothorax of usual form, neck stout........................**13. cribratum.**
Shining, bright rufous, front of head, prothorax and last two segments of abdomen black; prothorax narrowed in front; head with sides more obliquely rounded behind, neck small.*......**14. serpentinum.**

C. Head short behind the eyes and semicircularly rounded; eyes large, prominent, looking forwards, in consequence of the front being suddenly contracted into a broad muzzle; antennæ more distant from the eyes than usual; maxillary palpi long and slender, last joint conical, one-third the length of the preceding; hind trochanters very acute at tip. ♂ with the 4th ventral segment prolonged behind into an acute triangular process extending to the hind margin of the 5th segment; slightly foveate at the middle; 2d and 3d segments tumid, with an acute edge near the hind margin; 7th ventral acutely emarginate except in *lugubre;* ♀ 3d ventral with a round flat tubercle.

Brown, sparsely setose, head sub-opaque, sparsely and finely punctured; prothorax sparsely and finely punctured, with a broad, smooth, dorsal stripe; elytra finely and densely punctured and pubescent; legs rufo-testaceous†...................................**15. prospiciens,** n. sp.

D. Head prolonged behind the eyes, as usual; maxillary palpi with 3d joint more thickened at the tip, 4th small, acicular, conical, less than one-third as long as the 3d joint; ♂ with 3d ventral segment lobed behind. Black species, antennæ and legs pale rufous.

Head shining, coarsely and sparsely punctured, elytra coarsely punctured, almost in rows...**2.**
Head opaque, finely and densely punctured, front sparsely punctured; ♀ 3d and 4th ventral segments deeply transversely impressed, setigerous at the middle; elytra densely punctured.............**16. despectum.**

2. Head long, sides nearly parallel behind the eyes; in both sexes the 2d ventral segment has a small fovea bearing two black spines, in one sex the 3d segment has also a small fovea.............**17. lugubre,** n. sp.
Head somewhat obliquely narrowed behind the eyes: ♀ 2d and 3d ventral segments with small impressions............**18. obliquum,** n. sp.
Head obliquely narrowed behind the eyes, which are larger: ♀ 2d and 3d segments not impressed.........................**19. parcum,** n. sp.

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*This species seems allied to *C. Traili* Sharp, Staphyl. Amazon Valley, Trans. Lond. Ent. Soc. 1876, 221; these two species show an approach to the genus *Ophites*.

† Cryptobium *angustum* and *cylindricum Sharp*, op. cit. supra, 220, seem allied by the form of the head to this remarkable species.

E. Head prolonged behind the eyes as usual; maxillary palpi with 3d joint tumid, 4th very small, acicular not conical, less than one fourth the length of the 3d joint; ♂ with 3d ventral segment lobed behind.

Cylindrical, coarsely punctured, shining, black, antennæ and legs testaceous; (♀ not known.)................................**20. pusillum.**

Slender, brown, more finely punctured, size much smaller, legs pale; (♂ not known.)................................**21. lepidum**, n. sp.

88. [3.] **Cryptobium texanum,** n. sp.—Castaneous, sparsely pubescent, form and sculpture exactly as in *C. badium,* except that the segments 1–4 of the abdomen are black, and the 5th and 6th rufous, just as in *C. bicolor.* Length 8–11.2 mm.; .32–.44 inch.

♂. 3d ventral segment with a long, obtusely rounded process, setose at the sides and tip, and a deep round fovea near the anterior margin; 2d segment with two small approximate setigerous foveæ at the middle.

♀. 2d and 3d ventral segments not impressed.

Bosque Co., Texas, Mr. G. W. Belfrage. Differs from *C. badium* only by the color of the abdomen, and by the impression of the 2d ventral segment, which in that species is a transverse fold in both sexes.

39. [8.] **Cryptobium californicum,** n. sp.—Shining, black, pubescence fine. Head elongate, parallel behind the eyes, hind angles and base rounded, strongly punctured; front smooth, with 4 or 6 distant punctures; eyes rather convex, as long as the space from their front margin to the insertion of the antennæ. Prothorax narrower than the head, smooth dorsal stripe wide, sides sparsely punctured, punctures rather irregularly placed. Elytra strongly and densely punctured, not longer than the prothorax, abdomen finely and rather densely punctured. Antennæ brown, legs piceo-testaceous. Length 8 mm.; .32 inch.

♂. 6th ventral segment narrowly emarginate for one-half its length; base of emargination rounded.

California and Vancouver Island. Differs from *C. pallipes* by the much stronger punctuation, and much narrower and less triangular emargination of the 6th ventral segment of the male.

40. [9.] **Cryptobium flavicorne,** n. sp.—Black, shining, pubescence fine; head oblong-oval, less strongly punctured than in *C. californicum,* front smooth with a few scattered punctures. Prothorax scarcely narrower than the head, very slightly wider behind, smooth dorsal stripe wide, sides sparsely and strongly punctured, punctures not irregularly placed. Elytra densely less strongly punctured, less shining, not longer than the prothorax. Abdomen finely and densely punctured. Antennæ and legs yellow testaceous. Eyes of the same size as in *C. californicum,* but less convex. Length 8 mm.; .32 inch.

Massachusetts and Lake Superior, two females. Differs from *C. pallipes* by the head being longer and more parallel, and the antennæ yellow instead of brown. The elytra are more finely punctured, while those of the prothorax are quite perceptibly coarser.

41. [12.] **Cryptobium tumidum,** n. sp.—Slender, blackish-brown, pubescence fine. Head sub-ovate, gradually a little wider behind the eyes, which are rather smaller than in the two preceding species; densely punctured, front less shining, nearly smooth. Prothorax elongate-oblong, slightly but perceptibly narrower behind, smooth dorsal stripe broad, ill defined, sides sparsely and finely punctured. Elytra not longer than the prothorax, densely rather finely punctured. Abdomen finely punctured. Antennæ, palpi and legs dull ferruginous. Length 9.5 mm.; .375 inch.

♂ 6th ventral segment deeply emarginate for one-half of its length.

San Jose, California; found by me in March, 1850.

42. [15.] **Cryptobium prospiciens,** n. sp.—Brown, less shining; pubescence fine. Head finely not densely punctured, semi-circularly rounded behind the eyes, which are large and prominent; front produced into a broad muzzle with high antennal ridges, so as to make a broad frontal concavity, which is nearly smooth, marked only by a few large punctures. Prothorax elongate, slightly rounded on the sides, narrower than the head; smooth dorsal stripe wide, not distinctly defined; sides very sparsely and finely punctured. Elytra not longer than prothorax, finely punctured. Abdomen not shining, scarcely perceptibly punctulate. Antennæ, palpi and legs paler brown. Length 8 mm.; .32 inch.

♂ 3d ventral segment with a long triangular lobe nearly acute at tip, setose at the sides and end; there is a small transverse fovea at the middle; 6th ventral segment triangularly emarginate for nearly half its length. ♀ 3d ventral with a round flat slightly elevated tubercle.

Bosque Co., Texas, Mr. G. W. Belfrage; Arizona, Dr. Horn. This species is an excellent example of what is not unfrequently seen in other families; the union of characters which define two or more separate groups of species, with some peculiar character. In this instance the sexual characters of the ♂♂ of the two groups of § A are united, but the form of head is quite different from that seen in either of them.

43. [17.] **C. lugubre,** n. sp.—Slender cylindrical, shining black; legs, palpi and antennæ yellow, the latter darker at the base. Head as long as the prothorax and very little wider, sparsely strongly punctured, punctures

smaller and indistinct upon the front. Prothorax with smooth dorsal stripe broad, sides strongly sparsely punctured. Elytra with rather large punctures arranged somewhat in rows. Abdomen sparsely finely punctured, tip and posterior border of segments brown; ventral segments brown. Length 6 mm.; .24 inch.

♂ and ♀ 2d ventral segment with a small tubercle bearing two small stout black setæ resembling spines; ♂? 3d ventral segment marked with a small fovea.

The last joint of the maxillary palpi is about one-third the length of the 3d joint. The elytra are a little shorter than the prothorax.

Tampa and Enterprise; three ♀. On examining seven specimens, I find no difference in the ventral segments, except that in all of them the 2d (apparent) segment has a small transverse impression and fold, bearing spines; while in two of them the 3d segment has also a small round fovea at the middle, a little nearer the front than the hind margin. There is no difference in the size of the head.

44. [18.] **Cryptobium obliquum**, n. sp.—Slender, cylindrical, shining, black; antennæ, palpi, and legs yellow. Head as long as the prothorax, distinctly wider, sides oblique behind the eyes, and broadly rounded; eyes rather large, convex; sparsely punctured, front smooth, with only a few scattered punctures, the smooth space prolonged behind to between the eyes. Prothorax with smooth, dorsal stripe wide, not well defined; sides sparsely, strongly punctured, punctures arranged almost in rows. Elytra coarsely punctured, here and there almost in rows. Abdomen sparsely punctured, nearly smooth towards the tip, which is brown. Length 6 mm.; .24 inch.

♂ 3d ventral segment with a long, triangular setose process, rounded at tip; 2d and 3d segments not distinctly impressed.

♀ 2d and 3d ventral segments, each with a very small bisetose fovea.

Tampa; April, one pair. Quite different from *C. lugubre* by the form of the head.

45. [19.] **Cryptobium parcum**, n. sp.—Cylindrical. shining, black, antennæ, palpi, and legs yellow. Head as long as the prothorax, distinctly wider, sides oblique behind the eyes and broadly rounded; eyes rather large, convex; punctured as in *C. obliquum*. Prothorax with smooth dorsal stripe, sides sparsely coarsely punctured in rows. Elytra as long as the prothorax, coarsely punctured, here and there in rows. Abdomen sparsely less finely punctured, tip brown. Length 6 mm.; .24 inch.

♀ 2d and 3d ventral segments not impressed

Cedar Keys; June, one ♀. Differs from *C. obliquum* chiefly by the less slender form, coarser punctures of the prothorax, and absence of ventral impressions.

46. [21.] **Cryptobium lepidum,** n. sp.—Slender, less convex, ferruginous, shining, pubescence fine. Head oval, nearly as long as the prothorax, and wider than it, sides much rounded behind the eyes, which are rather large and convex; sparsely, equably punctured, front not less so than the rest of the surface; there are two long, but not deep frontal impressions. Prothorax with smooth dorsal stripe narrower than usual, limited each side by a row of points, which becomes a slightly impressed stria towards the base; sides rather sparsely punctured, almost in rows. Elytra distinctly longer than the prothorax densely, rather finely punctured. Abdomen sparsely punctured. Legs paler. Length 3.8 mm.; .15 inch.

Bosque County, Texas, Mr. G. W. Belfrage, two ♀. The ventral segments are not impressed. A very small and pretty species, less convex than the others in our fauna.

47. **Pæderus obliteratus,** n. sp.—Elongate, slender, reddish-yellow, shining; head and last two abdominal segments black; above yellow; elytra blue-black; antennæ brownish at the middle. Head sparsely punctured, slightly wider than the prothorax; the latter elongate-oval, feebly sparsely punctured, elytra not longer than the prothorax, sparsely but not coarsely punctured at the base, nearly smooth behind the middle. Dorsal segments very sparsely and finely punctured. Length 5 mm.; .20 inch.

♂ Sixth ventral cleft nearly to the base; cleft wide, rounded at the anterior extremity.

Southern part of Florida, Dr. Palmer; Mr. E. P. Austin gave me a similar specimen as found at Cambridge, Massachusetts. This species is easily distinguished by the finer punctures of the elytra becoming gradually obliterated behind.

Larger series of specimens have indicated to me the necessity of some modifications in the table of species of this genus published by Mr. Austin, (Proc. Bost. Soc. Nat. Hist. xix, 47); and I would propose to substitute for it the following synopsis:

Table of Species of PÆDERUS.

	Head not flattened in front	**2.**
	Head flattened in front	**femoralis.**
2.	Epistoma not margined in front	**3.**
	Epistoma concave, strongly margined; half of thighs, knees and greater part of tibiæ dusky	**grandis.**
	Epistoma not concave, finely margined	**riparius.**
3.	Antennæ brown, pale only at base	**4.**
	Antennæ with base and outer joints pale	**5.**

4. Prothorax ovate...**littoreus.**
Prothorax oval...**compotens.**
5. Prothorax ovate...6.
Prothorax oval...7.
6. Elytra shorter than prothorax, antennæ thickened externally..**palustris.**
Elytra as long as prothorax, antennæ very slightly thicker externally .. **littorarius.**
7. Head as usual, rather broadly oval, elytra strongly punctured, longer than prothorax...**floridanus.**
Head narrower, oval, but slightly wider than the prothorax; punctures of elytra effaced behind*.........................**obliteratus,** n. sp.

48. **Palaminus flavipennis,** n. sp.—Red brown, shining, sparsely setose, elytra yellow-testaceous, scarcely longer than the prothorax. Antennæ, palpi and legs pale yellow. Sculpture as in the other species. Prothorax strongly punctured, disc sub-carinate towards the base; not wider than long, ovate, much narrowed behind, sides oblique, slightly rounded. Length 3.4 mm.; .13 inch.

Tampa, Enterprise and Capron; not rare. Agrees in color with *P. pallipes*, but differs by the smaller size, and by the elytra being as long as, or very little longer than the prothorax. Abdominal segments alike in both sexes.

The species of *Palaminus* agree in form and sculpture, and the antennæ, palpi and legs in all are pale yellow. The other characters enable those in our fauna to be distinguished as follows:

Table of Species of PALAMINUS.

Piceous, elytra rufous or testaceous; terminal segments of abdomen alike in both sexes, not emarginate, nor incised..................2.
Uniform pale testaceous, abdomen sometimes darker............ 3.
2. Larger, elytra rufous, twice as long as prothorax...........**1. pallipes.**
Smaller, elytra as long as the prothorax..........**2. flavipennis,** n. sp.
3. Elytra much longer than the prothorax.............................4.
Elytra scarcely longer, sometimes shorter than the prothorax........5.
4. ♂ 7th ventral segment with two narrow incisions, middle lobe broad, rounded at tip; ♀ same segment feebly emarginate.**3. normalis,** n. sp.
♂ 7th ventral with middle lobe contorted and unsymmetrically curved, broadly truncate at tip; ♀ same segment deeply and broadly triangularly emarginate.................................**4. testaceus.**

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* NOTE.—I have omitted *P. ustus*, which belongs to a different group of species having the color nearly uniform testaceous. *P. nevadensis* Austin, does not differ from *compotens* Lec. By a confusion of specimens the remarks of Mr. Austin concerning *P. grandis* Austin, are incorrect; the species is easily known by the large size, equal to *P. femoralis*, and the strongly margined, concave epistome.

♂ 7th ventral with middle lobe longer and narrower, unsymmetrically curved, concave and truncate at tip ; ♀ same segment deeply incised, incision rounded at base........................**5. contortus**, n. sp.

5. Elytra evidently larger than the prothorax....... ....**6.**
Elytra not larger than the prothorax.................................**7.**

6. Elytra with more distant and less coarse punctures; prothorax but slightly narrowed behind...............................**6. lividus.**
Elytra with less distant and coarser punctures; prothorax much narrowed behind................. ....**7. cribratus**, n. sp.
Elytra with smaller punctures; prothorax less narrowed behind.......
8. pumilus, n. sp.

7. Elytra with large deep distant punctures..................**9. larvalis.**

49. **Palaminus normalis**, n. sp.—Yellow-testaceous, shining, sparsely setose. Prothorax transverse, very slightly narrowed behind, rounded on the sides. Elytra twice as long as the prothorax, rather densely but not coarsely punctured. Length 2.8 mm.; .11 inch.

♂ 7th ventral segment with two narrow incisions extending about one-third the length ; middle lobe broad, truncate behind.

♀ 7th ventral segment feebly emarginate.

Georgia and South Carolina. Easily distinguished from *P. testaceus* and *contortus* by the sexual characters.

50. **Palaminus testaceus** Er. Staphyl. 683. Length 2.8 mm.; .11 inch.

♂ 7th ventral segment with two deep narrow incisions, middle lobe unsymmetrical, curved, broadly truncate at tip.

♀ 7th ventral with a deep and broad triangular emargination.

Illinois; one pair collected by Mr. B. D. Walsh.

51. **Palaminus contortus**, n. sp —Of the same form and color as *P. testaceus*, yellow-testaceous, abdomen a little darker. Prothorax slightly narrowed behind, rounded on the sides. Elytra twice as long as the prothorax, less closely but more strongly punctured. Length 2.5 mm.; .10 inch.

♂ 7th ventral segment with two narrow deep incisions; middle lobe narrower, curved, convex, bent and emarginate at tip.

♀ 7th ventral deeply emarginate for one-half the length, emargination with parallel sides and rounded base.

Tampa, Sand Point, Enterprise; not rare.

52. **Palaminus cribratus**, n. sp.—Yellow-testaceous, shining, sparsely pilose; abdomen darker. Head and prothorax sparsely punctured, the latter nearly as long as wide, ovate, much narrowed behind, rounded on the sides. Elytra a little longer than the prothorax, coarsely, but not sparsely punctured. Length 2.8 mm.; .11 inch.

Tampa; one specimen, without sexual characters in the last abdominal segments.

53. **Palaminus pumilus,** n. sp.—Much smaller, yellow-testaceous, shining, sparsely pilose. Head and prothorax sparsely punctured, the latter nearly as long as wide, ovate, somewhat narrowed behind, rounded on the sides. Elytra a little longer than the prothorax, strongly not densely punctured. Length 2.1 mm.; .08 inch.

♂ 7th ventral segment with the posterior margin obliquely truncate each side and angulate at the middle.

♀ 7th ventral segment broadly rounded at tip.

Enterprise and Tampa; rare. Differs from *P. cribratus* by smaller size, prothorax less narrowed behind and elytra less coarsely punctured.

54. **Palaminus larvalis** Lec., New Sp. Coleopt. (Smiths. 8 vo.) 49. In this species the head and prothorax are sparsely and coarsely punctured; the prothorax is nearly as wide as long, ovate, strongly narrowed behind, and oblique on the sides, as in *P. cribratus;* the elytra are not longer than the prothorax and a little narrower, convex, very coarsely and sparsely punctured. Length 3.1 mm.; .12 inch.

New York, Tennessee; Palatka and Tampa, Florida. No sexual differences are apparent in four specimens examined. This species closely resembles *P. flavipennis*, but can be distinguished from immature specimens of that species by the elytra being a little narrower than the prothorax, and by the smooth dorsal line of the latter not being elevated towards the base.

55. **Brachypeplus glaber,** n. sp.—Elongate, very depressed, red-brown, abdomen piceous. Head and prothorax finely rather densely punctured, the latter more than one-half wider than long, scarcely narrower in front, sides nearly straight, slightly rounded near the anterior margin, which is truncate; sides finely margined, narrowly explanate towards the hind angles, which are rectangular. Scutellum finely punctured, transverse, 5-sided. Elytra about twice as long as the prothorax, striæ punctured, well impressed, interspaces flat, each with a row of punctures. Dorsal segments sparsely punctulate, *fimbriæ* widest behind, narrowest at the middle, with the inner outline concave; fimbria of last segment widest at base, gradually narrowed behind. Length 3.2 mm.; 13 inch.

Enterprise; May. Differs from all the tropical American species described by Murray (Trans. Linn. Soc., London, xxiv, 296), by the absence of pubescence. It therefore belongs to his sub-genus *Leiopeplus*, thus far known only from Western Africa.

SMICRIPS, n. g. (MONOTOMIDÆ).

Body elongate, sub-cylindrical, resembling in miniature a narrow species of Ips. Head as wide as the prothorax, not narrowed behind the eyes, which are small, rounded and convex; narrowed in front of the eyes, epistoma wider than long, with sides parallel, separated from the head by a very deep frontal suture. Labrum transverse, broadly rounded; mandibles strong, obtusely toothed. Palpi short, the labial ones broad. Mentum with parallel sides, longer than wide. Antennæ inserted in the clypeal suture, 11-jointed, joints 1 and 2 thick, 3–8 small, 9–11 forming a loose elongate club.

Prothorax nearly square, front angles rounded, side margin very fine; prosternum very narrow between the coxæ, which are very small, and far back, at the hind margin of the prothorax; coxal cavities small, oval. Middle coxæ separated by the narrow mesosternum. Hind coxæ widely separated. Ventral segments 5; 1st and 5th each as long as the three others united. Elytra parallel, scarcely wider than the prothorax, broadly truncate at tip, exposing a long pygidium. Legs rather short, tibiæ gradually thickened to the tip, where there are a few small spines; tarsi with the joints dilated, very short, last joint more than twice as long as the others united; claws rather large, simple.

56. **S. palmicola,** n. sp.—Elongate, reddish-testaceous, imperceptibly punctulate above and beneath, and finely pubescent; elytra with a transverse piceous cloud near the tip, and frequently another near the base. Length 1 mm.; .04 inch; varies a little larger or smaller.

♂ 5th ventral segment broadly impressed.

Tampa, Haulover and Enterprise; abundant on *Chamærops palmetto.* I have also a specimen from Georgia; a MS. drawing by my father bears the name *Nitidula minutissima* Dej. Cat.

The quadrangular epistoma and deep frontal suture will enable this small insect to be easily recognized. The maxillæ are unusually large and flat at the base, filling up the buccal cavity each side of the mentum.

57. **Scymnus balteatus.**—Elongate oval, brownish rufous, shining, punctulate and very finely, sparsely pubescent; elytra tinged with piceous, ornamented with a broad oblique yellow band in front of the middle. Beneath finely and densely punctured, post-coxal arcs entire, not extending to the sides of the abdomen; antennæ and legs paler rufous. Length 1.5 mm.; .06 inch.

Haulover and Sand Point; rare. This and the next are more elongate than our other species, except *S. punctatus* Mels., which, however, is more coarsely punctured, and of a different form, with the sides of the prothorax much less rounded.

58. **Scymnus quadritæniatus.**—Elongate-oval, dull brown, punctulate and clothed with fine short gray pubescence. Elytra black, each with two large yellow spots, one before, the other behind the middle; apical margin yellow. Prothorax rufous towards the sides, which are rounded and narrowed in front of the middle. Abdomen dark rufous, antennæ and legs paler. Beneath finely and densely punctured, post-coxal arcs extending to the 1st ventral suture, effaced on the outer side. Length 1.2-1.6 mm.; .05-.06 inch.

Varies with the yellow spots enlarged so as to become confluent.

Enterprise and Capron; rare. The variety is from Opelousas, La., and was kindly given me by Mr. Sallé. The anterior spot is oblique on the inner outline, and the posterior one is transverse, and slightly sinuate behind.

59. **Œneis pallida,** n. sp.—Broadly ovate, convex, impunctured, testaceous, shining, glabrous; prothorax finely margined at base; front tibiæ slender. Length 0.8 mm.; .035 inch.

Sand Point, one specimen. Precisely resembles *Œ. pusilla* in form and sculpture, but is very much smaller, and of a pale color.

60. **Pentilia misella,** n. sp.—Rounded-oval, convex, shining, black, glabrous. Prothorax finely margined at base, sides not explanate nor punctured. Elytra a little wider than the prothorax, distinctly punctured, suture finely margined. Length 1 mm.; .04 inch.

Tampa and Capron. A widely diffused species, found from Lake Superior to Florida, and from New York to Illinois. Sometimes abundant on the flowers of Thalyctrum. The two following species do not belong to this zoölogical province.

61. **Pentilia marginata,** n. sp.—Rounded-oval, convex, shining, black, glabrous; prothorax finely margined at base, sides sparsely punctured and narrowly explanate. Elytra finely punctured, suture finely margined behind the middle, wider than the prothorax at the base. Length 1.1 mm.; .045 inch.

Marquette, Lake Superior; Messrs. Hubbard and Schwarz. A little larger than *P. misella*, but of the same form.

62. **Pentilia ovalis,** n. sp.—Elliptical-oval, less convex, shining, dark brown, glabrous; prothorax finely margined at the base; sides impunctured, finely margined. Elytra scarcely wider at base than the pro-

thorax, finely punctured, suture finely margined behind the middle. Length 0.8 mm.; .03 inch.

Haulover and Enterprise; rare. Less broad than the other two species, and with the elytra more finely punctured.

63. **Saprinus dentipes** *Mars.* Mon. Histeroid. (Ann. Ent. Soc. Fr. 1855), 728; fig. 160. Convex-oval, bronzed. Head slightly rugose in front, marginal line deep with a badly impressed frontal chevron. Prothorax punctured at the sides and front, smooth at the middle; base with a narrow band of aciculate punctures. Elytra with a large, posterior subquadrate punctured space, extending from the sutural stria to the 3d dorsal, and from the end of the 1st dorsal to the apical margin; 1st and 2d dorsal a little longer than the 3d and 4th; the last named connected with the sutural, which is entire. Front tibiæ with 3 large and 3 small teeth; hind tibiæ with spines arranged in two rows; mesosternum smooth with the marginal line curved in front. Prosternum not compressed, striæ approximate, abbreviate in front, divergent behind. Length 3.2 mm., .125 inch.

Southern Florida; Dr. Palmer, two specimens. This and the next two species belong to my group VIII,* but it differs from those mentioned by Dr. Horn in having the punctured space of elytra limited in front by a transverse outline. The humeral stria, as usual, is long and fine, the external subhumeral wanting, the internal short, disconnected.

This species has been previously known only from Mexico, and is perhaps only a variety of the next.

64. **Saprinus braziliensis** *Mars.* Mon. Hist. (Ann. Ent. Soc. Fr. 1855), 726, fig. 159; *Hister braz.* Payk. Mon. Hist. 66, pl. 6, fig. 2.

Southern Florida; one specimen, Dr. Palmer. This species only differs from the preceding by the punctures of the elytra being more densely placed, and extending nearly to the base between the 1st and 4th dorsal striæ; a smooth, rounded mirror is thus left.

65. **Saprinus permixtus,** n. sp.—Convex-oval, bronzed. Head slightly rugose in front, marginal line deep, with a badly impressed frontal chevron. Prothorax punctured at the sides and front, smooth at the middle, base with a narrow band of aciculate punctures. Elytra punctured, with the sides and a large basal mirror smooth, punctures extending to the base between the 1st and 2d dorsal striæ; 1st dorsal longer than the others, extending farther behind than the inner marginal, which is connected with the elongate fine humeral; 2d, 3d and 4th striæ nearly equal, one-half the

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* *Vide* Horn. Proc. Am. Phil. Soc. 1873, 342.

length of the elytra; the last named connected with the sutural, which is entire. Front tibiæ with 3 large and 3 small teeth. Hind tibiæ with two rows of spines. Mesosternum smooth, with the marginal line curved in front. Prosternum with stria approximate, abbreviated in front, divergent behind. Length 3.8 mm.; .15 inch.

Cedar Keys; on the beach, rare. Also allied to the two preceding, and intermediate between them in the puncturing of the elytra. It differs chiefly by the first dorsal stria being prolonged behind, to within a short distance of the tip, as in *S. fraternus*, &c., though in a less degree.

66. **Epierus brunnipennis** *Mars.* Mon. Hister. (Ann. Ent. Soc. Fr. 1854), 697, fig. 18.

Specimens found at Enterprise and Haulover, agree perfectly with the description of this Mexican species, except that the elytra are piceous-black. The form is oval-convex, and it is easily distinguished by the 4th and 5th dorsal striæ being abbreviated in front, at about one-fourth from the base.

67. **Acritus salinus,** n. sp.—Oblong-convex, shining black, indistinctly punctured. Prothorax without basal row of punctures. Elytra somewhat more distinctly punctured towards the suture, and slightly rugose behind; sides smooth. Prosternal striæ strongly divergent in front, and twice as distant at the lobe as at base; mesosternum with sub-marginal stria entire. Front tibiæ moderately dilated, inner margin slightly curved. Length .8 mm.; .032 inch.

Cedar Keys, found only on the ocean shore.

68. **Atænius sculptilis** *Harold,* Col. Hefte. iii, 86.

A species found at Enterprise, agrees in all respects with the description of this Venezuelan insect. It is closely related to *A. cylindrus* Horn, but differs by larger size, and by the interspaces of the elytra being strongly costate. Length 4 mm.; .16 inch.

69. **Geotrupes chalybæus,** n. sp.—Rounded-oval, convex, very shining, blackish-blue, with metallic gloss. Prothorax with a few scattered punctures; sides much rounded, reflexed margin wider towards the base, which is distinctly margined. Elytra with rows of punctures in place of the striæ; sutural stria impressed, deeper towards the tip, which is armed with a small, acute sutural spine; side margin broadly flattened and reflexed near the base, narrower behind. Length about 21 mm.; .83 inch. Elytra 13.5 mm.; .535 inch.

♂ Front tibiæ with 4 large and several small conical teeth on the inner margin; apical process large, bent rectangularly, proximal edge obliquely sinuate towards the tip.

Tampa. I have described this species from fragments found by Mr. Schwarz. It is much larger than the other species in our fauna, as the elytra of the largest specimen of *semiopacus* in my collection are 12.5 mm.; .475 inch long.

This species seems to have a rather wide distribution in the Atlantic States. Dr. C. Zimmermann once told me that he had found a large blue *Geotrupes*, without impressed striæ, in South Carolina, and if I mistake not I have seen a similar specimen from Maryland, in Mr. Ulke's collection.

70. **Diplotaxis languida,** n. sp.—Elongate, sub-cylindrical, pale-brown; head strongly punctured, epistoma depressed, margin strongly reflexed, broadly truncate in front, angles obtuse and rounded. Prothorax about twice as wide as its length, more narrowed in front, less narrowed behind, sides with an obtuse, rounded angle just behind the middle; disc strongly punctured. Elytra with the ordinary rows of punctures, interspaces coarsely and strongly punctured. Front tibiæ with two large teeth; claws cleft. Length 6.2 mm.; .25 inch.

Tampa; abundant.

71. **Anomala** (Rhombonyx) **semilivida,** n. sp.—Oval, piceous, shining, more or less whitish testaceous above, elytra usually entirely pale. Head sparsely punctulate, epistoma pale, concave, rounded in front, margin strongly reflexed. Prothorax twice as wide as long, much narrower in front. Sides rounded, very finely margined, base similarly margined; disc sparsely punctulate, with a large transverse dark cloud, sometimes occupying nearly the whole surface. Scutellum large, rounded behind, dark colored. Elytra with the usual punctured equidistant striæ. First interspace wider, with a confused row of punctures from the base to the middle; outer striæ somewhat effaced. Legs usually margined with pale; claws simple. Body beneath, thighs and margin of elytra with long hairs. Length 6.5 mm.; .25 inch.

Tampa and Capron. The inner claw of the front tarsi is toothed near the base and then suddenly bent, with the lower outline slightly sinuate to the tip in four specimens examined; this is probably a sexual mark of the ♂, though one of the specimens is much stouter in form than the others.

72. **Taphroceras lævicollis,** n. sp.—Very small, slender, convex, narrower behind, black-bronzed, shining. Head and prothorax nearly smooth, the former large, longitudinally impressed; the latter with very deep oblique impressions towards the sides, which are nearly straight and

sub-parallel. Elytra uneven, with vague rows of feebly impressed striæ. Length 2.5 mm.; .10 inch.

Enterprise; one specimen. Easily recognized by the small size, large head, not narrower than the prothorax, and by the latter not being narrowed in front.

73. **Nematodes punctatus,** n. sp.—Elongate, scarcely narrower behind, brown, pubescent, strongly punctured. Epistoma at base equal in width to the space from it to the eyes. Antennæ nearly half as long as the body, with the 2d and 4th joints equal, 3d a little longer, 5th and 6th still longer, sub-equal; outer joints longer than wide, equal. Prothorax wider than long, scarcely narrowed in front, feebly channeled behind; strongly and densely punctured. Elytral striæ well-impressed, interspaces strongly punctured, feebly convex towards the base. Beneath punctured, last ventral obtusely pointed, and roughly asperate with elevated granules. Length 5.5 mm.; .21 inch.

Enterprise; one specimen. A specimen from Texas (Belfrage) agrees in all respects except that the antennæ are short and less slender, with the 3d joint more evidently longer than the 2d or 4th. I am disposed to think the difference is sexual.

74. **Anchastus longulus,** n. sp.—Elongate, pubescent, red-brown, elytra and legs paler. Head densely and strongly punctured, front not concave, margin fine, not reflexed. Prothorax nearly one-half longer than wide, strongly and densely, not coarsely punctured, narrowed in front, sides nearly straight, hind angles bicarinate Elytra with punctured striæ, interspaces nearly flat, finely not densely punctured. Antennæ with 3d joint one-half longer than the 2d; united equal to the 4th. Length 10 mm.; .40 inch.

Enterprise; one specimen. A smaller specimen (7.2 mm.; .29 inch) from Louisiana was given me by Mr. Sallé, which is a little less elongate, but not otherwise different.

75. **Anchastus fuscus,** n. sp.—Elongate, pubescent, dark fuscous above, red-brown beneath. Head coarsely punctured; punctures umbilicate, front broadly concave. Prothorax coarsely punctured, longer than wide, gradually narrowed in front, sides straight, hind angles unicarinate. Elytra with coarsely punctured striæ, interspaces convex, sparsely and finely punctured. Antennæ brown, half as long as the body, strongly serrate, 2d joint very small, 3d as large as the 4th. Length 7.5 mm.; .30 inch.

Enterprise, June; one specimen.

76. **Anchastus asper,** n. sp.—Smaller and more robust, dark brown,

clothed with long pubescence. Head coarsely punctured, punctures not umbilicate, front flattened, not concave. Prothorax not longer than wide, narrowed in front, sides straight, hind angles unicarinate; disc strongly, sub-rugosely punctured. Elytra black, striæ well-impressed, interspaces convex, rough with strongly marked, but not densely placed small elevations. Antennæ longer than the head and prothorax, strongly serrate, 2d joint small, 3d as large as the 4th. Length 4.7 mm.; .18 inch.

Cedar Keys, June.

77. **Athous debilis**, n. sp.—Small, very elongate, rufo-testaceous, pubescent. Head punctured, front not concave, broadly rounded, or subtruncate anteriorly. Prothorax (♂) nearly twice as long as wide, slightly narrower in front, hind angles produced, acute, not carinate, not divaricate; surface densely, rather finely punctured. Elytra with narrow sutural brown line, striæ deep, interspaces flat, punctulate. Antennæ not serrate, half as long as the body; 2d and 3d joints equal, together a little longer than the 4th. Length 4.6 mm.; .18 inch.

Lake Harney, May; one specimen. The 3d joint of the tarsi is very distinctly lobed.

78. **Cyphon impressus**, n. sp.—Elongate-oval, not convex, piceous, pubescent. Antennæ and legs piceo-testaceous. Head, prothorax and elytra equally densely punctulate, the last without elevated lines; about one-sixth from the base is a strong curved impression extending to the suture, and behind the middle a still deeper oblique one, not attaining the suture; between these two pairs of impressions the suture is slightly elevated. Antennæ with the 3d joint slender, equal in length to the 2d, not shorter than the 4th. Length 2.3 mm.; .09 inch.

Tampa, end of April. The impressions of the elytra and the suture behind the posterior one are paler and almost testaceous.

79. **Lucidota luteicollis**, n. sp.—Elongate, black, pubescent. Prothorax bright yellowish-red, sub-triangular, apical angle rounded, basal angles sub-acute; sides oblique, base broadly emarginate, side margins depressed and reflexed, more widely towards the base, apex and sides scabrous, disc nearly smooth, finely channeled. Scutellum red. Elytra finely and densely scabrous, each with two obsolete elevated lines, side margin narrow. Antennæ (♂) nearly two-thirds as long as the body, compressed, joints only slightly narrowed at the base, so that they are very feebly serrate. Last two ventral segments rufo-testaceous. Length 8 mm.; .32 inch.

Sumter County; two ♂. Resembles the New Mexican *Photinus collaris* Lec. in form and color, but differs in the antennæ being much longer and compressed, as in our other

Lucidotæ. *L. thoracica* from Mexico has been considered as identical with *P. collaris*, but differs by more robust form, red scutellum, coarser sculpture, and by the reflexed margin of the elytra being much broader. The abdomen of both sexes is entirely without phosphorescent organs, and the antennæ are more distinctly serrate than in *L. luteicollis*.

80. **Photinus** (Pyractomena) **ecostatus,** n. sp.—Elongate, head and prothorax pale; the latter a little longer than wide, rounded on the sides, narrower in front, and less broadly rounded at apex, sides depressed, scarcely punctured, edge dusky for the greater part of the length; disc finely carinate, with a dark stripe, narrow at the apex, broad at the base, which is bisinuate; hind angles rectangular, blunt at tip. Scutellum dark. Elytra finely and densely scabrous, narrowly margined, without discoidal elevated lines, sutural, lateral and apical margin pale; a narrow discoidal vitta extends from near the humerus to behind the middle. Antennæ dark, shorter than the prothorax. Beneath pale, meso- and metathorax, and two series of large transverse ventral spots dark; phosphorescent organs on 5th and 6th segments, as two pairs of oval slightly depressed spots of a honey yellow color. Legs piceous, trochanters and proximal half of thighs pale. Length 14.5 mm.; .57 inch.

Key West; one ♀, Mr. Edw. Burgess. Allied to *Ph. borealis*, but differs by the elytra being more finely scabrous and entirely without elevated lines.

81. **Photinus** (Pyractosoma) **nitidiventris,** n. sp.—Very elongate, pale. Prothorax with sides broadly flattened, sparsely punctured, marked with an elongate lateral dusky spot, disc with a broad dark dorsal stripe. Elytra densely scabrous, without elevated lines, strongly margined; sutural, apical and lateral margins pale; a narrow dorsal vitta runs from near the humerus to beyond the middle. Meso- and metathorax fuscous; abdomen pale; 2d and 3d segments with a quadrate spot each side half way between the median line and the side; 4th segment with a large transverse dark spot each side, remaining segments bright yellow, 5th and 6th each with a pair of pits connected with the phosphorescent organs, resembling large spiracles. Antennæ shorter than the prothorax, dark, base pale. Legs dark, trochanters and base of thighs testaceous. Length 14 mm.; .55 inch.

Enterprise; one ♂ specimen. The scutellum is testaceous and the prothorax rather narrowly rounded at apex; in another specimen from Capron the scutellum is cloudy, and the apex of the prothorax is broadly rounded. Nearly allied to *P. angustata*, but in that species the sides of the prothorax are not dusky, while the head and the first four ventral segments are entirely dark. Also nearly allied, but different by the densely punctulate phosphorescent segments, is the following species.

82. **Photinus** (Pyractosoma) **punctiventris**, n. sp.—Very elongate, of the same form, size and color as *P. nitidiventris*, with the sides of the prothorax fuscous; the 1st–4th segments of abdomen are not spotted, but fuscous, a little paler at the edges. The phosphorescent segments are finely and densely punctulate. The discoidal elevated lines of the elytra are distinct. Length 13 mm.; .50 inch.

Texas; three ♂; Austin, Mrs. V. O. King; Bosque Co., G. W. Belfrage.

83. **Photinus** (Pyractosoma) **collustrans**, n. sp. — Elongate, fuscous. Prothorax yellow, tinged with orange at the middle, a little longer than wide, sides parallel behind, regularly rounded into the apex before the middle, margins widely reflexed, scabrous; disc sparsely punctulate, shining, finely channeled, between the middle and the apex is a transverse fuscous spot. Scutellum yellow. Elytra pubescent, coarsely scabrous, each with two faint elevated lines; sutural, apical and lateral margin narrowly bordered with yellow, side margin narrow, not reflexed. Beneath fusco-piceous, 5th and following ventral segments (♂) yellow, 5th and 6th phosphorescent, each with a pair of rounded impressions, having a pore at the bottom. Antennæ fuscous, not longer than the prothorax. Legs fuscous, anterior and middle more or less testaceous. Length 7.2 mm.; .285 inch.

Tampa and Enterprise; two ♂.

84. **Photinus** (Pyractosoma) **umbratus**, n. sp.—Of the same size, form, color and sculpture as *P. collustrans*, but differs by the prothorax having an elongate black spot, extending from near the base to the anterior scabrous portion, this spot is wider in front than behind; the elytra are more strongly margined at the side. The antennæ are longer and more slender, extending beyond the base of the prothorax, and the 1st joint is pale. Length 7.5 mm.; .30 inch.

♂ 4th and following ventral segments yellow, 4th and 5th phosphorescent, each with a pair of small pits with a pore at the bottom; 5th broadly emarginate behind, 6th small, emarginate, 7th small, rounded at tip.

♀ The black spot of the prothorax extends to the apex; the ventral segments are black, and only the 4th has a transverse oval phosphorescent spot of pale yellow at the middle, the 5th segment is not emarginate, the 6th is flat, prominent and slightly notched at tip.

Tampa, Baldwin, Capron; May and June. Two much smaller females seem to indicate other species, which with more material may be properly defined. It seems to me unsafe to propose names for them at present.

1st. Capron. 5.5 mm.; .22 inch. The prothoracic black stripe extends from the base to the tip; the scutellum is dark, the 6th ventral segment has a small rounded pale yellow phosphorescent spot, besides the large one of the 4th segment.

2d. Cedar Keys. 3.8 mm.; .15 inch. The prothoracic black stripe extends from the base nearly to the tip; the scutellum is dark, the epipleuræ are piceo-testaceous, and there is no phosphorescent spot on the 6th ventral.

85. **Ozognathus floridanus**, n. sp.—Black, shining, scarcely perceptibly and thinly clothed with very short pubescence, punctulate, antennæ and legs piceous. Prothorax twice as wide as long, convex, sides margined, very much rounded, hind angles very small, rectangular, slightly prominent. Length 1.4 mm.; .05 inch.

Tampa; two specimens, one of which was most kindly sent me by Mr. Schwarz. The sides of the prothorax are very much more rounded than in *O. cornutus*, and the pubescence is much shorter. The ♂ is not known.

This is an interesting addition to the genera common to Florida or the Antilles and California.

86. **Hemiptychus debilis**, n. sp.—Elongate-oval, convex, red-brown, shining, clothed with very fine prostrate pubescence, almost imperceptibly punctulate. Prothorax short, rounded at base, slightly emarginate at apex, side angles deflexed, sub-acute when viewed laterally. Elytra with two deep striæ extending from the middle nearly to the apex. Beneath sparsely, finely punctured with sparse shallow punctures on the sides in front of the middle. Antennæ and tarsi yellowish. Length 1.9 mm.; .075 inch.

Enterprise; one specimen. Resembles *H. ventralis*, but the lateral striæ of the elytra are longer, and the surface is sparsely covered with shallow punctures at the sides near the base; the form is a little less elongate.

Hemiptychus similis, n. sp.—Elongate-oval, convex, less rounded in front than behind, blackish brown, less shining, finely densely punctulate and finely pubescent. Prothorax more distinctly punctured towards the sides. Elytra with two deep striæ extending from the middle to near the tip; punctures more distinct at the sides and in front. Beneath finely punctulate. Length 2.3 mm.; .09 inch.

Tampa; one specimen.

87. **Hemiptychus abbreviatus**, n. sp.—Oval, convex, equally rounded before and behind, dark-brown, with a slight reddish tinge, imperceptibly punctulate and very finely pubescent. Elytra sparsely, finely

punctulate, striæ two, deep, beginning about one-fourth from the apex; the outer one meets a very short trace of the sutural stria; the inner one is shorter than the outer one. Under surface scarcely perceptibly punctulate. Length 2.2 mm.; .085 inch.

Capron; one specimen. Easily known by the short striæ, and very fine pubescence.

88. **Hemiptychus auctus,** n. sp.—More elongate-oval, convex, equally rounded before and behind, sub-opaque, indistinctly punctulate, reddish-brown, densely clothed with short, yellowish pubescence. Elytra with the outer stria beginning just behind the middle, joining a short remnant of the sutural stria; 2d stria beginning farther back, and joining a trace of the sub-sutural stria inside of the 2d stria; beginning at the middle, and running backwards for a short distance is an indistinct 3d stria, in the direction of which is situated a large granule. Beneath indistinctly punctulate. Length 1.5 mm.; .06 inch.

Capron; one specimen. I do not observe anything similar to the granule, or elevated puncture above mentioned in any other species. It is situated about one-fifth from the apex.

The species of *Hemiptychus* here described are to be incalated in the table (Proc. Acad. Nat. Sc. Phila. 1865, 239), between *H. ventralis* and *obsoletus*. Several other species allied to *H. gravis*, are indicated in the collections of Dr. Horn and myself, but until larger series of specimens are obtained, I think it is undesirable to describe them.

89. **Catorama punctulata,** n. sp,—Elongate-oval, convex, blackish-fuscous, rather shining, thinly clothed with fine, prostrate, very short pubescence, distinctly but finely punctured. Beneath similarly punctured, antennæ and front tarsi yellow-brown. Length 2.5 mm.; .10 inch.

Tampa; one specimen. The pubescence has a sericeous reflection, where it is well preserved.

90. **Catorama holosericea,** n. sp.—Elongate-oval, convex, fuscous, densely clothed with short, gray, erect hair, producing a velvet silvery lustre; elytra each with a large, oblique spot about the middle, and a smaller round posterior one without lustre, and consequently appearing darker; surface imperceptibly punctulate. Length 1.5 mm.; .06 inch.

Enterprise; three specimens.

91. **Catorama minuta,** n. sp.—Oval, convex, fuscous brown, uniformly finely punctulate, and thinly clothed with fine pubescence. Length 1.1 mm.; .045 inch.

Enterprise; two specimens. This species is slightly more robust than the others, and is easily known by the very small size, and fine though not indistinct punctures.

The following species from California and Texas may be conveniently described at the present time.

92. **Catorama frontalis,** n. sp.—Sub-cylindrical, rounded at each end, brown, somewhat shining, very finely and densely punctulate, clothed with fine, short, sericeous pubescence. Head with the curved frontal impression deep, side margin of front stronger than in the other species, and narrowly reflexed. Prothorax with the hairs so arranged as to give the appearance of a slight elevation at the middle of the base. Length 4.2–6 mm.; .17–.25 inch.

Santa Barbara; one specimen, collected by Mr. G. R. Crotch. Of the same size, form, color and sculpture as *C. simplex*, but differs by the sericeous pubescence, and more strongly margined front. On comparison, the sides of the elytra are seen to be more broadly and distinctly concave, but this difference is not very obvious.

Catorama sectans, n. sp.—Elongate-oval, convex, blackish, clothed with extremely fine brown pubescence, distinctly punctulate. Elytra with the punctures towards the sides arranged somewhat in rows, and with indistinct traces of two striæ near the base. Beneath distinctly punctured, antennæ yellow-brown. Length 3.3 mm.; .13 inch.

Texas; Dr. Horn. Very like *C. punctulata*, but larger, with the fine punctures of the elytra arranged in rows near the sides and with slight traces of the two outer striæ near the base, thus showing a tendency towards *Hemiptychus.*

93. **Catorama obsoleta,** n. sp.—Elongate-oval, convex, brown, imperceptibly punctulate and finely pubescent. Elytra with some feeble traces of striæ at the sides, especially near the base. Length 2.4–3.3 mm.; .10–.13 inch.

Southern part of California; one specimen collected by Mr. Hardy was kindly given me by Dr. D. Sharp. This species is very similar to *C. punctulata*, but is of a browner color, and not distinctly punctulate.

Table of Species of CATORAMA.

Larger sub-cylindrical, very finely and densely punctulate..........**2.**
Smaller, elongate-oval..**3.**
2. Front strongly margined at the sides, pubescence sericeous............
1. frontalis, n. sp.
Front as usual, finely margined at the sides, pubescence not sericeous..
2. simplex.

3. Pubescence coarse, sub-erect, velvety............**3. holosericea,** n. sp.
Pubescence very fine..**4.**
4. Blackish, distinctly punctulate, elytra with rows of punctures towards the sides.......................................**4. sectans,** n. sp.
Blackish, distinctly punctulate, elytra without rows of punctures......
5. punctulata, n. sp.
Red-brown, imperceptibly punctulate................**6. obsoleta,** n. sp.
Smaller, less elongate, finely punctulate..............**7. minuta,** n. sp.

94. **Dorcatoma granum,** n. sp.—Sub ovate, convex, blackish-brown, shining; pubescence sparse, fine, erect. Prothorax punctulate. Elytra sparsely, finely punctured, punctures arranged somewhat in rows; two outer striæ deep, and a short, less deep one at the margin near the base. Beneath brown, sparsely and finely punctured, metasternum truncate in front. Length 1.5 mm.; .06 inch.

Enterprise; two specimens. More robust than *D. setulosum*, and much smaller.

95. **Dorcatoma tristriatum,** n. sp.—Oval convex, less rounded in front, shining, black, thinly clothed with short, sub-erect gray pubescence. Head and prothorax finely punctulate. Elytra finely, densely punctured, with three striæ near the side; these striæ begin in front of the middle, the outer two extend nearly to the tip, while the 3d is much shorter, ending about one-fourth from the tip. Beneath finely punctured (antennæ not seen). Length 2.5 mm.; .10 inch.

Bosque County, Texas; Mr. G. W. Belfrage, one specimen.

96. **Cænocara lateralis,** n. sp.—Broadly ovate, convex, black, shining, sparsely and finely punctured, pubescence gray, sparse, erect. Prothorax more densely punctured towards the sides. Elytra with 1st and 2d striæ deep, entire; the 3d extends from the base for one-third the length; the lateral lobe has a distinct marginal stria. Beneath strongly punctured. Length 1.5 mm.; .06 inch.

Enterprise; one specimen. This species closely resembles the small form of *C. oculata*, in shape, color, and sculpture, but differs by the lateral lobe of the elytra, which has a distinct marginal stria. The eyes, as in *C. oculata*, are almost divided by a narrow acute emargination. The antennæ are yellow-brown.

97. **Cænocara intermedia,** n. sp.—Ovate, convex, brownish-black, shining, finely sparsely pubescent. Head finely punctulate, emargination of the eyes rounded at the end, less deep. Prothorax finely punctulate. Elytra finely punctulate in rows; lateral lobe faintly striate; outer stria entire, deep, 2d stria deep from the base for three-fourths the length,

where it is abbreviated; 3d stria wanting. Beneath finely sparsely punctured. Antennæ and tarsi yellow-brown. Length 2 mm.; .08 inch.

North Carolina; Dr. Zimmermann, one specimen. This species resembles *Dorcatoma* in the sculpture, but the form is more robust, and the eyes emarginate to near the middle.

98. **Cænocara californica,** n. sp.—Broadly ovate, convex, black, shining, with fine sparse sub-erect hairs. Head and prothorax rather densely punctulate. Elytra less densely punctulate, with three striæ near the sides; 1st and 2d entire, 3d beginning at the base and extending one-third the length; there is no marginal stria. Beneath finely punctured (antennæ not seen). Eyes almost divided. Length 1.5 mm.; .06 inch.

California; one specimen received by Dr. Horn. Very similar to the small form of *C. oculata*, but differing by the more densely punctured prothorax, and more finely punctured under surface.

Table of Species of CÆNOCARA.

Broadly ovate; eyes nearly divided by a deep narrow emargination; 1st and 2d striæ of elytra entire; 3d extending one-third the length. **2.**
Less broadly ovate, eyes emarginate only to the middle; 2d stria of elytra abbreviated behind, 3d obsolete.......... **5. intermedia,** n. sp.
2. Elytra sparsely finely punctured.................................. 3.
Upper surface equally densely and finely punctured; lateral lobe of elytra without a stria.............................. **4. scymnoides.**
3. Lateral lobe of elytra without stria.................................. 4.
Lateral lobe of elytra with a distinct marginal stria. Head and prothorax finely punctured.............................. **3. lateralis,** n. sp.
4. Head, prothorax and elytra very sparsely punctulate........ **1. oculata.**
Prothorax more densely punctulate............... **2. californica,** n. sp.

BYRRHODES, nov. gen. (ANOBIINI.)

Body rounded, slightly oval, convex, pubescent with coarse hairs. Head inflexed, broad, mandibles resting against the metasternum in repose; under surface——. Antennæ 10-jointed; 1st joint large, auriculate, 2d nodose, rather large, attenuated at base, 3d slender, 4th and 7th subtransverse, gradually slightly wider (4th appears to be indistinctly impressed transversely); 8th triangular, as long as the whole stem, from the 2d to the 7th; about twice as wide as long, remaining joints broken. Palpi not seen. Eyes not convex, not emarginate, partly covered behind by the prothorax. Prosternum not seen, front coxæ deeply sunk in the cavity, not seen. Mesosternum concealed by the metasternum, which is produced in front into a broad square process, the anterior margin of which is slightly rounded, and the front angles are acutely prominent laterally. The posterior part of the metasternum is large, sparsely punctured, with a median impressed line, each side of which is a shallow round impression. Legs slender. rather long, middle coxæ separated by the metasternal process; middle legs received in transverse excavations, which extend on the epipleuræ; hind legs received in excavations which occupy the whole of the length of the 1st ventral segment, and extend to, but not upon, the edge of the elytra; tarsi broad, 1st joint not elongate, 5th not narrower nor longer than the 4th; claws small, divaricate, appendiculate, ventral segments 5, as usual; 1st short, occupied by the excavations for the hind legs; 2d, 3d and 4th equal, each about twice as long as the 1st; 5th nearly as long as the two preceding, broadly rounded; the sutures are equally plain and straight. Elytra striate.

This genus is allied to *Dorcatoma* and *Cœnocara*, but differs from both by the elytra being striate, by the 2d joint of the antennæ being larger, and by the form of the metasternal process which is much narrowed at base in *Dorcatoma*, and very short in *Cœnocara*. Having seen but one specimen, I am unwilling to risk it by an attempt to expose the prosternum, especially as the genus is very well characterized without reference to that part.

99. **Byrrhodes setosus,** n. sp.—Robust, oval, convex, obliquely narrowed in front, blackish-brown (somewhat shining where the hair is removed), densely clothed with coarse white curled hairs, very finely and densely punctulate. Head with a transverse frontal impressed line near the margin; sides obliquely margined. Prothorax short, of the same form as in *Cœnocara*, outline when viewed from above oblique. Scutellum flat, rounded. Elytra with well impressed striæ, the two outer ones deeper behind the middle; interspaces wide, flat, the outer ones slightly convex behind; lateral edge finely margined from base to tip. Beneath nearly smooth, very sparsely punctulate. Sterna glabrous (by abrasion ?), abdomen hairy. Length 3.5 mm.; .14 inch.

Capron; one specimen. On superficial view, this insect might be readily mistaken for a small species of *Byrrhus*.

100. **Elaphidium tectum,** n. sp.–Elongate, slender, brown, clothed with short fine rather dense dirt colored pubescence, scarcely mottled on the elytra. Antennæ (♂) as long as the body, joints 3–10 each with a spine at the inner apical margin; the spine of the 3d is about one-fourth as long as the 4th joint, the others diminish gradually in length; the outer apical angle of the joints 5–7 is also armed with a small spine. Prothorax a little wider than long, moderately rounded on the sides, densely punctured, with a smooth dorsal line more distinct behind the middle, and a discoidal round callus each side in front of the middle; on the deflexed sides near the base are seen a few large round punctures or foveæ. Elytra

coarsely not densely punctured, punctures smaller towards the tips, which are bispinous, the outer spine much longer than the sutural. Thighs of the hind legs with a short spine on the inner side. Length 15.6 mm.; .63 inch.

Cedar Keys; two ♂. This species is related to *E. mucronatum* and *incertum*, but the antennæ are not longer than the body, and the pubescence is more uniform; the punctures of the elytra are also more distant. It seems to resemble *E. lanatum* Chevr. (Am. Ent. Soc. Fr. 1862, 260) from Cuba, and I should consider it as the other sex of the same species, except that the outer angle of the 3d and 4th joints is not armed with a spine.

101. **Leptostylus transversatus** Chevr. Ann. Ent. Soc. France, 1862, 248.

Enterprise. The specimens agree perfectly with the description given of this Cuban species, which was not previously known in our fauna.

102. **Leptostylus arcuatus**, n. sp.—Fuscous, densely clothed with gray hair. Elytra flattened on the disc, hind third of surface smoky-brown, limited in front by a curved blackish line, concave forwards; this line is angulated about the middle of the width, then again concave forwards, and joins a lateral narrow black line, which is dilated behind the humerus; asperities black, sparse, small, arranged in distant rows; tips strongly and obliquely truncate, outer angle prominent; punctures coarse, rather densely placed. Prothorax without discoidal inequalities, nearly twice as wide as long, sides oblique from apex to beyond the middle, where they are distinctly angulated, then narrowed to the base; there is a small black spot extending from the base to the lateral angle. Beneath brown, finely pubescent, not mottled, legs scarcely mottled; antennæ a little longer than the body, punctured and annulated. Length 8 mm.; .32 inch.

Tampa; one specimen. A very distinct species. The 1st joint of the hind tarsi is as long as the two following, and the lateral angle of the prothorax is obtuse, not rounded, but also not prominent, and is distinctly nearer the base than the apex, while in all the others in our fauna it is at the middle of the side, and obtusely rounded. It might be properly referred to *Sternidius*, but in that genus the lateral angle of the prothorax is more prominent. Until another revision of this division of *Cerambycidæ* is made, I prefer to place this species in *Leptostylus*, rather than to establish it as a separate genus.

ZAPLOUS, n. g. (Cerambycidæ, subf. Lamiidæ.)

Body small, not very robust, clothed with prostrate, short pubescence. Head rather short, not channeled, support of labrum coriaceous, eyes rather coarsely granulated, deeply emarginate, upper part much smaller than the lower. Antennæ a little shorter than the body, 11 jointed, with very few flying hairs on the lower edge; 1st joint long, slender, slightly clavate (very much as in *Leptostylus*, *Liopus* &c.); 2d joint cylindrical, nearly one third as long as the 1st; 3d and 4th elongate, together equal to the remaining ones united, which gradually diminish in length, but not in thickness. Prothorax wider than long, not tuberculate, sides rounded, sometimes indistinctly angulated; front coxal cavities widely angulated. Elytra wider than the prothorax, parallel, humeri well rounded, tips rounded, not truncate. Front coxæ prominent, narrowly separated, middle coxæ more widely separated, cavities open externally. Legs short, thighs stout, but not clavate; front tibiæ with inner groove feeble; middle tibiæ with a slight but distinct tubercle on outer margin. Tarsi short, not slender, 1st joint scarcely longer than 2d; last joint long, claws divaricate.

The small insect which indicates this genus belongs to the tribe Pogonocherini (Lec. Class. Col. N. Am. 340), but does not fit well into any of the groups thus far known in our fauna.*

103 **Zaplous Hubbardi,** n. sp.—Brown, clothed with short, prostrate yellowish-gray pubescence, somewhat mottled by unequal distribution. Prothorax very densely, rather finely punctured. Elytra more strongly and less densely punctured. Antennæ annulated with black, finely punctulate and pubescent, without mixture of large punctures. Length 3.3–5 mm.; .13–.20 inch.

Enterprise; frequently beaten from old vines, in May.

104. **Donacia rugosa,** n. sp.—Coppery-bronze, not shining, rugose, rather robust, sub-depressed. Head channeled in front, line deeper behind, and ceasing between the eyes; eyes convex, prominent, orbits wide. Prothorax quadrate, a little wider in front, where the angles are well-marked, sides not sinuate; surface densely rugose and punctured, dorsal line widely impressed but vague, feebly, transversely impressed near the base. Elytra obliquely narrowed towards the tips, which are truncate; discoidal impressions vague, the 1st small, near the scutellum; the 2d large, in front of the middle; the 3d small, near the suture, and behind the middle; striæ composed of elongate punctures, interspaces densely, transversely rugose. Beneath dark plumbeous, with fine, pruinose pubescence. Hind thighs (♀) not toothed, antennæ slender, three fourths as long as the body, blackish. Length 9.2 mm.; .37 inch.

Enterprise; May, one specimen. Allied to *D. subtilis*, but less shining, and more rugose, with the antennæ longer and more slender.

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* *Vide* Horn, Tr. Am. Ent. Soc. vii, 43; (Jan. 1878).

105. **Diabrotica vincta,** n. sp.—Black, prothorax bright yellow, quadrate, smooth, with two large discoidal foveæ, side margin narrowly reflexed. Elytra wider than prothorax, punctured somewhat in rows, with the lateral and apical border, and a narrow vitta from the base to the tip, occupying an elevated ridge parallel with the suture, pale yellow. Beneath yellow, meso- and metathorax, outer half of thighs, tibiæ and tarsi black. Antennæ black, base brownish; 3d joint longer than 2d, united equal to the 4th. Length 4 mm.; .16 inch.

Capron; April, one specimen.

106. **Œdionychis indigoptera,** n. sp.—Dull ferruginous, antennæ and legs piceous; elytra blue-black, strongly and densely punctured, narrowly margined. Head sparsely punctured, median line abbreviated in front, and interrupted at the vertex; there are two small rounded foveæ between the eyes. Prothorax transverse, narrowed in front, sub sinuate, but scarcely rounded on the sides, which are broadly flattened; front angles small, prominent; disc smooth, not shining. Hind thighs very large, finely and sparsely punctured. Length 3 mm.; .12 inch.

Tampa; one specimen. The 5th ventral segment is widely concave at the tip. This species is not closely allied to any other known to me in our fauna; the middle tibiæ are angulate on the outer margin as in *Œ. thyamoides* Crotch.

106. **Argopistes scyrtoides.** n. sp.—Circular, not very convex, rufous, extremity of hind thighs, and the upper surface black, shining. Head brown. Prothorax very short, deeply emarginate in front, rounded at base, finely punctulate; a curved, transverse, rufous band extends from the base each side, near the hind angles; the sides are also rufous. Elytra scarcely perceptibly punctulate, marked with distant striæ composed of extremely fine punctures; each with a large, triangular, rufous spot, with the apex in front, extending to the suture behind the middle. Length 3.4 mm.; .135 inch.

Florida; two specimens given me by Mr. Ulke. The resemblance of this insect to a small *Exochomus* is marvellous. The genus is also remarkable for having occurred thus far only in north-eastern Asia. The mesosternum is entirely concealed between the pro- and metasternum, and the latter is very short. The hind thighs are immensely large in proportion to the size of the insect. Though the next species has not occurred as yet in Florida, its geographical distribution renders its appearance there very probable.

107. **Sphæroderma opima,** n. sp.—Rounded, nearly circular, convex, piceous-black, shining; antennæ and legs (except hind femora) dark-brown. Head punctured, eyes not immersed in the prothorax. Prothorax short, sides oblique, front angles rounded; surface finely punctulate. Elytra with irregular rows of sparse, coarse punctures, interspaces nearly smooth. Length 2.5 mm.; .10 inch.

North Carolina and Texas. I have adopted the manuscript specific name given by Dr. Zimmermann. This is the first introduction of the genus into the literature of our fauna; *Sphærodcrma insolita* Mels. is the type of *Cerataltica* Crotch, and belongs in another group.

108. **Chætocnema pinguis,** n. sp.—Sub-ovate, convex, more pointed behind; coppery bronze, not very shining, base of antennæ, tibiæ and tarsi testaceous. Prothorax finely alutaceous, transverse, not narrowed in front, sides rounded near the front angles; disc finely punctured. Elytra with fine punctured stria, interspaces flat, smooth. Sides of last ventral segment finely punctured. Length 2.2 mm.; .09 inch.

Enterprise and New Smyrna, two specimens. Very like *C. denticulata*, but more pointed behind; the sculpture is much finer and the last ventral segment is not coarsely and sparsely punctured, but is nearly smooth at the middle and finely punctured towards the sides.

109. **Chætocnema protensa,** n. sp.—Very elongate-oval, moderately convex, coppery bronze, not very shining; antennæ black bronzed, tibiæ and tarsi brown. Head strongly and sparsely, front more densely punctured. Prothorax transverse, not narrowed in front, rounded on the sides, punctured. Elytra with striæ composed of large punctures, interspaces flat, smooth, ventral segments sparsely punctured. Length 2.8 mm.; .11 inch.

Detroit, Michigan; one specimen; Messrs. Hubbard and Schwarz. Much larger than *C. elongatula* Crotch, but of equally elongate form.

110. **Chætocnema cylindrica,** n. sp.—Elongate, sub-cylindrical, convex, coppery bronze, not very shining: antennæ and legs of the same color. Head and prothorax strongly, rather closely punctured, the latter transverse, not narrowed in front, rounded on the sides. Elytra a little wider than the prothorax, striæ composed of deeply impressed punctures, interspaces smooth. Ventral segments rather finely punctured. Length 2 mm.; .08 inch.

Detroit, Michigan; Messrs. Hubbard and Schwarz. Also found in Massachusetts. The punctures of the short scutellar stria, and the base of the sutural stria are somewhat confused.

111. **Chætocnema opacula,** n. sp.—Elongate-oval, convex, elytra wider than the prothorax, dark black bronzed. Head opaque, impunctured. Prothorax transverse, not narrowed in front, sides broadly rounded, front angles not truncate; surface opaque, finely, densely punctured, base with an indistinct row of punctures. Elytra moderately shining, striæ composed of punctures of moderate size, not closely set. outer striæ impressed. Base of antennæ brown, legs dark. Length 1.5 mm.; .06 inch.

California, Gilroy; one specimen, Mr. G. R. Crotch. The antennæ are broken and but two basal joints remain.

112. **Chætocnema flavicornis,** n. sp.—Oval, convex, dark bronze, not very shining, antennæ yellow, scarcely darker at the outer extremity. Head smooth, with the usual impressions. Prothorax finely punctured, narrowed in front of the middle, post apical angle distinct; there is also a basal puncture each side opposite the base of the 6th stria. Elytral striæ composed of small, close-set punctures, interspaces obsoletely punctulate. Length 1.4 mm.; .055 inch.

Detroit, Michigan; one specimen. Easily known by the small size, robust form and yellow antennæ. The legs are dark, and the ventral segments sparsely punctured. The obliquely cut front angles of the prothorax and the basal puncture indicate a tendency toward *Crepidodera.*

113. **Chætocnema obesula,** n. sp.—Still smaller, oval, convex, black bronzed, not very shining, antennæ and legs dark. Head smooth, with the usual impressions. Prothorax transverse, sides oblique, narrowed in front, surface alutaceous, obsoletely punctulate; base finely margined with a transverse row of punctures. Elytral striæ composed of large strongly impressed punctures, interspaces slightly convex, smooth. Abdomen nearly smooth, slightly punctured at the sides and tip. Length 1.2 mm.; .05 inch.

Lake Ashby and Baldwin; two specimens.

114. **Chætocnema decipiens,** n. sp.—Narrower and less regularly oval, bronzed black, tibiæ, tarsi and antennæ testaceous, the last slightly brown at the extremity. Head smooth, with the usual impressions. Prothorax transverse, not narrowed in front, sides very slightly rounded; post-apical angle somewhat distinct, with a very long seta; disc punctured. Elytra a little wider than the prothorax, striæ impressed, punctured, interspaces convex, smooth. Abdomen nearly smooth. Length 1.5 mm.; .06 inch.

Kansas, one specimen. Of the same form as *C. pulicaria*

Mels. (*vide* Crotch, Proc. Acad. Nat. Sc. Phila., 187 , 75), but easily distinguished by the strongly punctured prothorax.

115. **Chætocnema cribrata,** n. sp—Oval, convex, bright bronze, tibiæ and tarsi rufo-testaceous, base of antennæ brownish. Head deeply but not coarsely punctured. Prothorax transverse, gradually narrowed in front, slightly rounded on the sides, densely punctured. Elytra deeply and coarsely punctured, punctures forming striæ only on the posterior declivity and at the sides. Abdomen strongly punctured. Length 2.1 mm.; .085 inch.

Cambridge, Mass.; one specimen, collected by Mr. Schwarz in February, under moss.

Table of species of CHÆTOCNEMA.

Head punctured....................2.
Head smooth or nearly so....................5.
2. Inner striæ of elytra confused....................3.
Striæ of elytra quite regular....................4.
3. Oval convex, elytral striæ confused, punctures coarse..1. **cribrata,** n. sp.
More elongate, less convex, elytral striæ confused only near the base and suture....................2. **irregularis.**
Elongate, cylindrical, elytral striæ slightly confused near the base and suture....................3. **subcylindrica,** n. sp.
4. Robust oval, elytral striæ strong....................4. **denticulata.**
Robust oval, elytral striæ fine....................5. **pinguis,** n. sp.
Very elongate-oval, head more sparsely punctured....6. **protensa,** n. sp.
5. Oval or ovate, not very elongate....................6.
Very elongate-oval, shining, head sparsely punctulate....7. **elongatula.**
6. Prothorax strongly punctured, base finely margined....................7.
Prothorax punctured, base with a row of punctures....................8.
Prothorax punctured, without basal row of punctures....................10.
Prothorax obsoletely punctulate....................11.
7. Greenish black, opaque, convex ; striæ strongly punctured..8. **alutacea.**
Blue-green, rather shining ; antennæ and front legs brown, elytral striæ closely punctured....................9. **subviridis.**
Greenish-black, shining, more elongate, less convex ; base of antennæ pale ; elytral striæ impressed, closely punctured..10. **decipiens,** n. sp.
Greenish-black, convex, elytra wider than prothorax ; antennæ and legs yellow ; prothorax straight on the sides....11. **quadricollis** *Schwarz.*
8. Less robust, elytra wider than prothorax, which is finely punctured..9.
Robust, ovate, prothorax strongly punctured....................10. **crenulata.**
9. Bronzed, shining....................11. **parcepunctata.**
Black bronzed, head and prothorax opaque.........12. **opacula,** n. sp.
Dark bronzed, shining, less convex....................13. **pulicaria.**

10. Ovate, convex, somewhat shining, prothorax with a basal puncture each side, antennæ, tibiæ and tarsi testaceous.......**14. flavicornis**, n. sp.
Ovate, convex, less shining. prothorax without basal puncture, antennæ, tibiæ and tarsi testaceous..............................**15. confinis.**

11. Robust, ovate, head and prothorax alutaceous, elytra more shining, with striæ composed of very large punctures.......... **16. obesula**, n. sp.

116. **Blapstinus fortis**, n. sp.—Elongate-oval, not convex, grayish-black, sparsely pubescent. Head strongly punctured. Prothorax one-half wider than long, narrower in front, sides slightly rounded, apex deeply emarginate, base bisinuate; surface densely, strongly punctured, punctures towards the sides somewhat elongated. Elytra with coarsely punctured striæ, interspaces moderately convex, punctured. Flanks of prothorax beneath coarsely punctured and aciculate, deeply concave and nearly smooth along the margin. Abdomen strongly punctured. Length 7 mm.; ·28 inch.

♂. Joints 1–3 of front and middle tarsi dilated, spongy beneath.

Southern Florida; one specimen, collected by Dr. Palmer. This species is closely allied to *B. dilatatus*, but the prothorax is much less rounded on the sides, and proportionally a little longer.

116. **Blapstinus opacus**, n. sp.—Elongate-oval, rather convex, black opaque with a silky lustre. Head and prothorax sparsely punctulate, the latter nearly twice as wide as long, narrower in front, sides slightly rounded, finely margined; apex strongly emarginate; base strongly bisinuate, finely margined. Elytra with rows of small elongate punctures in place of striæ; 7th and 8th row as usual not attaining the base. Beneath nearly smooth, last ventral segment more distinctly punctured; flanks of prothorax with a few rugosities, concave along the margin. Length 6.1 mm.; .24 inch.

Southern Florida; one specimen, collected by Dr. Palmer. The ♂ tarsi are dilated as in the preceding species.

117. **Blapstinus estriatus**, n. sp.—Robust oval, very convex, black, not shining. Head and prothorax distinctly punctured, the latter nearly twice as wide as long, narrower in front, very slightly rounded on the sides and finely margined; apex moderately emarginate, front angles less prominent than usual; base bisinuate, finely margined; margin obsolete at the middle. Elytra more finely punctured than the prothorax, with obsolete traces of striæ behind and at the sides. Beneath strongly and densely punctured. Length 4.3 mm.; .17 inch.

Haulover and Capron; not rare. The tarsi are not dilated in any of the specimens examined. Should the sexes be alike in this respect, which may be known only by dissection, this character, added to the convex form of body, and the absence of elytral striæ, would require the separation of this insect as a distinct genus.

DIGNAMPTUS, n. g. TENEBRIONIDÆ; HETEROTARSINI.

Body elongate, resembling *Stenochia.* Head short, eyes large, transverse, coarsely granulated. Antennæ as long as the head and prothorax, rather slender. 3d joint a little longer than the 4th; 8th, 9th and 10th wider and larger, scarcely as long as wide, 11th longer, oval. Palpi with the last joint strongly securiform, mentum obovate, transverse, with two shallow impressions. Prothorax sub-cylindrical, slightly rounded and subsinuate on the sides, which are narrowly margined, hind angles small, acute, or rectangular. Elytra a little wider than the prothorax sub-cylindrical, humeri not prominent, striæ composed of large close punctures, interspaces narrow. Epipleuræ narrow, not reaching the tip, impinged upon by the 4th and 5th ventral segments, which are rounded at the sides. Legs long, slender; tarsi with the 1–3 of the front and middle pair broad, and the 1st and 2d of the hind pair less dilated, brush-like beneath; penultimate joint small, last joint as long as the others united, claws large, simple.

118. **Dignamptus stenochinus,** n. sp.—Elongate, shining black, with a bluish gloss. Head densely punctured. Prothorax more strongly punctured, one-half longer than wide, sub-sinuate on the sides behind the middle; hind angles small, acute, prominent. Elytra with striæ of very coarse punctures; interspaces narrow, smooth. Flanks of prothorax coarsely, meso- and metasternum sparsely punctured. Abdomen sparsely finely punctured. Length 7. mm.; .28 inch.

Enterprise; June, beaten from dead vines; very rare. Has very much the appearance of a small *Stenochia.*

119. **Dignamptus langurinus,** n. sp.—Linear-elongate, black, with a slight metallic gloss. Antennæ stouter, more strongly and more gradually thickened externally, the 6th and 7th joints being wider than the preceding, though not so wide as the following. Head finely punctured. Prothorax strongly punctured, one-half longer than wide, slightly narrower behind, hind angles rectangular, not prominent. Elytra slightly wider than the prothorax, striæ composed of oval punctures, in distance equal to their long diameters, interspaces wider than the striæ, flat, smooth. Beneath as in the preceding. Length 4 mm.; 16 inch.

Enterprise; May, very rare. This species has much the appearance of a *Languria*, and the more thickened antennæ tend to increase the resemblance.

120. **Phaleria punctipes,** n. sp.—Oval, convex, black, or piceous, sometimes testaceous above but without spots. Prothorax narrowed in front, rounded on the sides, especially near the apex, base finely margined,

with a large, basal puncture each side. Elytra finely striate, interspaces wide, flat, smooth. Under surface towards the sides very finely scabro-punctulate. Legs black, front thighs nearly smooth, middle and hind thighs coarsely and sparsely punctured; tibiæ densely punctured. Length 7 mm. .28 inch.

Haulover; abundant on the ocean shore. Larger and stouter than *P. testacea*, and easily known by the black and coarsely punctured legs. In this respect it resembles *P. pilifera* from Lower California, from which it differs only by the epipleuræ being smooth and glabrous, while in *P. pilifera* they are punctured and setose.

121. **Platydema crenatum,** n. sp.—Oval, rather elongate, convex, black, shining. Head punctured in front, transverse impression faint. Prothorax sparsely, finely punctulate, base bisinuate, not margined, each side with a broad, shallow impression. Elytra with deep, very coarsely punctured striæ. Beneath punctured, last two ventral segments nearly smooth. Antennæ, palpi and tarsi brown; prosternum convex between the coxæ, point inflexed, not prominent. Length 4.5 mm.; .18 inch.

Haulover; one specimen. More convex than *P. lævipes*, and very distinct by the coarsely punctured elytral striæ.

122. **Hypophlœus glaber,** n. sp.—Cylindrical, red-brown, shining, with erect hairs. Head densely and finely punctured, transverse line well-impressed. Prothorax longer than wide, convex, finely punctured, sides nearly straight, finely margined, front angles not prominent, almost rounded. Elytra finely, rather densely punctured. Pygidium equally, densely, finely punctured. Abdomen less densely punctured, 5th ventral segment vague, impressed Length 3 mm.; .12 inch.

Tampa; two specimens, also found in Georgia, under pine bark. This species is smaller, narrower and more convex than *H. parallelus*, and differs by the front angles of the prothorax not being acute and prominent. It has the same form as *H. thoracicus* and *piliger*, but differs by the elytra being more finely punctured, without erect hairs, and by the pygidium being not sparsely but densely punctured.

I do not find mentioned in any work that the 3d, 4th and 5th ventral segments in this genus are longitudinally, deeply impressed near the sides, so that the margin appears to be thickened.

123. **Hypophlœus piliger,** n. sp.—Slender, cylindrical, convex, red-brown, shining. Head punctured, transverse line obsolete, front with

a shallow, rounded impression between the eyes. Prothorax longer than wide, sides slightly rounded, near the apex and base, hind angles rectangular, rounded at the extreme tip, finely not densely punctured, with a few erect hairs towards the sides, base not margined. Elytra finely not densely punctured, punctures here and there, forming rows (but not indicating striæ); there are some erect hairs, especially near the tip, and at the sides. Pygidium sparsely punctured. Beneath punctured, last ventral segment not impressed. Length 2.5 mm.; .10 inch.

Florida, Georgia and South Carolina; under pine bark. I have adopted the name which it bears in the collection of Dr. Zimmermann. This species is more slender than *H. parallelus*, and differs by the sparse, erect hairs, by the punctures of the elytra being less fine and more distant, and by the pygidium being sparsely punctured. In these respects it agrees with *H. thoracicus*, but differs in color, and by having fewer erect hairs.

Three new species remain in my collection, which may be described on the present occasion; the subjoined table gives the essential characters of all the species in our fauna.

124. **Hypophlœus substriatus,** n. sp.—Very dark brown, cylindrical, less convex than the other species. Head punctured, transverse line well impressed, vertex with a faint, transverse impression, anterior to which the surface is more convex. Prothorax scarcely longer than wide, punctured, side margin stronger than in the other species, base margined. Elytra rather strongly punctured, punctures in rows except near the sides and tips, without hairs. Pygidium densely, finely punctured. Beneath punctured; last ventral segment broadly impressed, apical part convex. Length 4.2 mm.; .18 inch.

Oregon; collected by Lord Walsingham. Much larger than *H. parallelus*, and easily distinguished by the less convex form, more strongly margined prothorax, and by the elytral punctures being stronger, and placed in rows.

125. **Hypophlœus opaculus,** n. sp.—Cylindrical, convex, blackish, not shining. Head feebly punctulate, transverse line bounded behind by an obtuse, transverse ridge; epistome convex. Prothorax a little wider than long, sides broadly rounded, apex not emarginate, sides very finely margined, base indistinctly margined, surface finely, rather densely punctured. Elytra finely punctured, punctures here and there in rows. Pygidium densely, finely punctured. Beneath sparsely punctured; 5th ventral with a small, apical tubercle. Length 3.2 mm.; .13 inch.

Southern California; one specimen collected by Mr. Hardy, kindly given me by Dr. D. Sharp. The convex transverse ridge of the head causes the clypeal impression to appear very deep.

126. **Hypophlocus tenuis,** n. sp.—Very slender, cylindrical, convex, red-brown, shining, antennæ and legs ferruginous. Head sparsely punctulate, transverse impression deep. Prothorax one third longer than wide, front and hind angles rounded at the extreme tip; apex not emarginate, sides very finely margined, base indistinctly margined, surface sparsely punctulate. Elytra punctured, with indications of striæ behind the middle, and near the suture. Pygidium sparsely punctured. Beneath sparsely punctulate; 5th ventral segment more strongly punctured, not impressed. Length 2.2 mm.; .09 inch.

Lowell, Massachusetts; collected by Mr. Frederick Blanchard, and kindly given to me by Dr. Horn.

Table of the Species of HYPOPHLŒUS.

Shining, sides of prothorax finely margined........................2.
Shining sides of prothorax strongly margined, head with a faint interocular transverse impression; 5th ventral segment broadly impressed.
1. **substriatus,** n. sp.
Opaque, sides of prothorax very finely margined, head with a transverse elevated ridge; 5th ventral segment with a small, apical tubercle....
8. **opaculus,** n. sp.
2. Entirely glabrous, prothorax not impressed........................3.
Clothed with long, erect hairs, prothorax broadly concave in front; 5th ventral segment not impressed..........................2. **cavus.**
With a few stiff, erect hairs; prothorax not impressed; 5th ventral not impressed; head with a shallow interocular impression............4.
3. Prothorax emarginate in front, apical angles acute; 5th ventral slightly impressed, pygidium densely punctured................3. **parallelus.**
Prothorax not emarginate in front, apical angles rounded; 5th ventral segment slightly impressed; pygidium densely punctured...........
4. **glaber,** n. sp.
Prothorax not emarginate in front, apical angles rounded; 5th ventral segment not impressed, pygidium sparsely punctured..5. **tenuis,** n. sp.
4. Brown, elytra black, antennæ and legs ferruginous......6. **thoracicus.**
Uniform red-brown, erect hairs less numerous.........7. **piliger,** n. sp.

127. **Strongylium simplicicolle.**—Black, somewhat shining. Head sparsely punctured, vertex longitudinally impressed, epistome thickened, transversely impressed in front of the clypeal suture, foveate at the middle near the anterior margin. Prothorax quadrate, wider than long, slightly rounded on the sides in front, angles not rounded, sides not margined, disc punctured, inflexed flanks sparsely and strongly punctured. Elytra with striæ more finely punctured than in *S. terminatum.* Antennæ

with the 2d and 3d joints united equal to the 4th, but not so wide. Length 10.5 mm.; .42 inch.

Enterprise; one mutilated specimen. Quite distinct by the prothorax being not margined at the sides, and by the 3d joint of the antennæ being much shorter than the 4th, which is as broad as the following ones, and subtriangular in form. The eyes, as in our other black species, are widely separated.

Table of the Species of STRONGYLIUM.

Black; eyes moderate, widely separated..........................**2.**
Greenish-bronze, very coarsely sculptured, prothorax not margined, sides slightly toothed; eyes large, nearly contiguous....**5. crenatum.**
2. Prothorax finely margined at the sides; 3d joint of antennæ longer than 4th..**3.**
Prothorax not margined; 3d joint of antennæ shorter than 4th; epistome thickened in front......................**4. simplicicolle**, n. sp.
3. Epistoma not thickened in front; last joint of antennæ yellowish....**4.**
Epistoma thickened in front; striæ of elytra very coarsely punctured.. **3. anthrax** *Schwarz.*
4. Thorax wider than long, feebly channeled.............**2. terminatum.**
Thorax longer than wide..............................**1. tenuicolle.**

128. **Xylophilus nubifer,** n. sp.—Moderately elongate, black, densely and finely punctured, clothed with sub-erect pale pubescence. Head brownish in front, eyes large, coarsely granulated, hairy; front narrow. Antennæ brown, longer than the head and prothorax, somewhat thickened externally; 2d joint thicker and a little shorter than the 3d; 11th as long as the two preceding wider, obliquely truncate at tip, with the apical angle acute. Prothorax wider than long, vaguely impressed. Elytra dark piceo-testaceous, with a scutellar cloud, a rounded spot one-fourth from the base, and a broad, angulated band about the middle, blackish; this band is extended along the lateral margin almost to the humeral callus; punctures strong, not very dense; wider than the prothorax base truncate, sides parallel, rounded behind. Beneath finely, sparsely pubescent; palpi, front tibiæ, and all the tarsi brown-testaceous. Length 2 mm.; .08 inch.

Enterprise; one specimen, probably a ♂. More allied to *X. ater* and *fasciatus*, than to any other species in my collection.

Table of Species of XYLOPHILUS.

Eyes hairy..**2.**
Eyes glabrous, widely separated, not oblique.........................**6.**
2. Hind angles of head rounded, not prominent; ♂ antennæ with the last joint elongate, cylindrical..................................**3.**

Hind angles of head prominent, rounded at tip......................4.

Hind angles of head dentiform, setose; eyes oblique, coarsely granulated, deeply emarginate; ♂ antennæ flabellate, eyes very large; color dark, elytra with pale, angulated lines.........**1. Melsheimeri.**

3. Brownish-black, base of elytra orange......................**2. basalis.**

Grayish-black, elytra with an angulated, narrow band of gray pubescence about the middle..............................**3. nebulosus.**

4. Eyes coarsely granulated...5.

Eyes finely granulated, smaller, not oblique, widely distant; black, shining, antennæ, legs and elytra yellow; the last with the base, apex, lateral cloud, and large, cordate spot at the middle black..**9. notatus.**

5. Entirely black, strongly punctured..........................**4. ater.**

Piceous, strongly punctured, antennæ and legs testaceous: elytra rufous, with a broad, piceous band occupying two-thirds of the surface, extending along the suture to the base. ....**5. fasciatus.**

Piceous, strongly punctured; elytra dull testaceous, with an ill-defined, oblique band and some anterior spots darker........**6. nubifer, n. sp.**

Testaceous, strongly punctured; head, and two small spots on each elytron, forming a transverse band, dark............**7. subfasciatus.**

Testaceous, strongly punctured; elytra each with two small piceous spots arranged obliquely, the inner one being behind the middle, and the outer one about the middle.........................**8. signatus.**

6. Elongate, like a slender *Anthicus* in form ....7.

Elytra large, ventricose, piceous, finely and very densely punctured, with numerous anastomosing lines of white pubescence; 1st joint of antennæ very short..............................**10. ventricosus.**

7. Head and prothorax finely punctulate..............................8.

Head and prothorax densely punctured; elytra more strongly punctured with two narrow bands of white pubescence, the anterior one angulated, black; antennæ and legs dull testaceous..... ....
11. ptinoides *Schwarz.*

8. Prothorax quadrate, transversely impressed near the base, elytra obliquely impressed behind the base..............................9.

Prothorax sub-ovate, not transversely impressed behind; form more elongate; color variable.....................**12. quercicola** *Schwarz.*

9. Fuscous, pruinose, elytra paler with an indistinct, darker band near the base; prothoracic impressions not deep..........**13. brunneipennis.**

Piceous, pruinose; antennæ and legs brown or testaceous...**14. piceus.**

Piceous, sparsely and finely pubescent, prothoracic impression very deep; antennæ and legs paler.......................**15. impressus.**

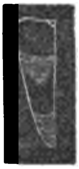
NOTE.—By an error of writing I have stated on p. 265 of Classification of Coleoptera of North America that in this genus the *penultimate* joint of the tarsi is bilobed; the *antepenultimate* is meant.

129. **Dircæa prona,** n. sp.—Very elongate, narrower behind, subcuneiform, convex, brown, densely clothed with sericeous short pubescence.

Head scabrous, bent perpendicularly downwards. Prothorax scabrous-punctate, very convex, a little longer than wide, subsinuate and broadly rounded in front, feebly rounded on the sides, truncate at base; at the sides, feebly emarginate at the middle; front angles rounded, hind angles rectangular. Elytra with the basal margin elevated, finely scabrous near the base, roughness gradually becoming very fine and dense punctuation behind. Antennæ slender; 1st, 3d and 4th joints equal in length, 2d shorter. Maxillary palpi with the 2d joint long, triangular, 3d shorter, triangular, not narrower, 4th not wider than 2d and 3d, elongate, cultriform, three times as long as its width at the base. Length 12 mm.; .48 inch.

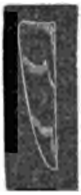
♂ Front tarsi with 4th joints broadly dilated, spongy beneath; 4th joint not narrower, deeply bilobed. ♀ wanting.

Enterprise; very rare in dead oaks. The prothorax is more prominent and convex in front than in *D. liturata*, and overhangs the head, almost as in *Lymexylon sericeum.*



130. **Mordella fascifera,** n. sp.—Piceous, pubescent, with cinereous hair. Prothorax with three large spots, extending from near the base to the middle, fuscous. Elytra with the anterior third (divided by a narrow sutural gray line), and a broad oblique band behind the middle fuscous; the band forms at the suture an angle directed forwards. Beneath thinly pubescent; base of antennæ, palpi and legs piceo-testaceous. Length 2.3 mm.; .09 inch.

Cedar Keys; one specimen. The form is somewhat robust as in *M. triloba*, and the anal process is long and slender. The length is given exclusive of the process.

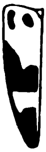


131. **Mordella angulata,** n. sp.—Black, finely pubescent, elongate. Elytra with two cinereous somewhat oblique transverse spots, one at the anterior third, the other at the second third of the length; these spots are each connected at the inner end with an oblique line running backwards to the suture. Anal process long and slender. Length 2.7 mm.; .11 inch.

Lake Ashby; one specimen. Longer and narrower than the preceding, having the form of many *Mordellistenæ*, or of *Mordella discoidea.*

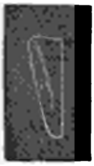
132. **Mordella triloba** Say.—Specimens taken at Enterprise, in May, differ from Northern specimens by the elytral fasciæ being much narrower; and the anterior one is strongly angulated so that the basal spot becomes acutely triangular; the humeral region is dull ferruginous. I am unwilling to describe it as distinct, but regard it rather as a well-marked variety.

Though not belonging to the same zoölogical province, the two following species may be conveniently described here:



133. **Mordella jovialis**, n. sp.—Black, pubescent, with the margins of the prothorax cinereous pubescent. Elytra densely cinereous pubescent with black markings as follows: two small spots near the base, the outer one elongate, the inner one round; a transverse broad band at the middle, divided by a cinerous sutural line, the anterior outline of this band is nicked outside of the middle, and then runs obliquely forwards, almost to the side margin, which is cinereous; the apical fourth is also black, divided almost to the tip by the cinereous sutural line. Beneath thinly clothed with pruinose cinereous pubescence, ventral transverse bands and hind coxæ blackish. Length 4.7 mm.; .19 inch.

Bosque County, Texas, G. W. Belfrage; one specimen. Of the same form and size as *M. oculata*, to which it is allied.



134. **Mordella obliqua**, n. sp.—Black, pubescent. Head cinereous, prothorax with scattered cinereous hairs, and two indistinct vittæ more densely cinereous. Elytra with a very narrow sutural line, and an oblique stripe from the humeri to beyond the middle, where it becomes obsolete, cinereous. Scutellum cinereous. Beneath black; anal process long and slender. Length 4 mm.; .16 inch.

Maryland, Dr. Zimmermann; Detroit, Michigan, Mr. E. A. Schwarz. In form and size this species resembles *M. marginata*. It is possible that *M. lunulata* Helmuth (Proc. Ac. Nat. Sc. Phila. 1865, 96), may have been a specimen of this species, with the elytral vitta partly effaced. The type has, I believe, been destroyed.

135. **Conotrachelus ventralis**, n. sp.—Not robust; elytra narrowed behind from the base, humeri not dentiform. Blackish-brown, thinly clothed, but scarcely mottled with coarse pale yellowish hairs. Beak half as long as the body, slender, brown, shining, sparsely punctured, striate each side for more than one-half the length. Antennæ inserted about one-third from the tip. Head strongly punctured, pubescent. Prothorax as long as wide, widest at the base, gradually narrowed and slightly rounded on the sides to the apex, near which it is feebly constricted; very deeply, coarsely and densely punctured, elevated dorsal line very narrow, indistinct. Elytra at base about one-half wider than the prothorax, humeri rounded, acutely margined, prominent, sides obliquely converging behind; fully one-half longer than the width at base, striate composed of large foveæ, interspaces not costate at base, but the 3d and 5th become gradually acute behind the middle; 7th acute for the

whole length. united in front at a sharp angle with the 9th, which is also acute for its whole length, the two united then form the humeral margin. Beneath, inflexed flanks of prothorax densely, metathorax more coarsely but sparsely cribrate; ventral segments very shining, with a few scattered large punctures, more numerous on the 5th. Legs long, thighs strongly unidentate, not annulated. Length 6 mm.; .25 inch.

Enterprise; one specimen. Quite different from any other in our fauna; it should be placed after *C. cratægi*, (vide Lec. and Horn, Rhynch., 230), between 1–Ba and 1–Bb.

136. **Conotrachelus cognatus,** n. sp.—Blackish; elytra mottled with dull fulvous; pubescence short, irregularly condensed. Head punctured, pubescent. Beak not half as long as the body, rather slender, very slightly curved, not shining, strongly striate. Antennæ inserted less than one-fourth from the tip. Prothorax wider than long, sides strongly rounded in front, nearly straight near the base; constricted near the apex; very coarsely and densely cribrate, not carinate. Elytra one-half wider than the prothorax at the base, oblong, rounded behind, humeri rounded; striæ composed of large quadrate punctures, interspaces narrow, not flat, 3d, 5th and 7th acutely but not strongly costate; 9th acute from the middle to within a short distance from the tip; at the base of the 3d interspace is a small spot of white scales. Beneath, mesosternum prominent, metasternum cribrate; ventral segments sparsely, 5th more densely punctured, impressed near the tip. Legs long, thighs unidentate, with a ring of gray pubescence. Length 4.3 mm.; .17 inch.

Tampa; one specimen. This species has the mesosternum produced into a small process in front, as in *C. posticatus*, from which it differs chiefly by the prothorax being not carinated, and by the somewhat less robust form.

137. **Conotrachelus pusillus,** n. sp.—Similar to the preceding, but very much smaller, blackish-brown, with irregularly condensed pubescence; elytra mottled with dull fulvous. Head punctured, yellow pubescent; beak longer than head and prothorax, stout, curved, deeply striate. Antennæ inserted one-fourth from the end, brown. Prothorax wider than long, rounded on the sides, broadly constricted near the apex, densely and coarsely punctured, not carinate. Elytra nearly one-half wider than the prothorax at base, oblong-oval, humeri rounded; striæ composed of large punctures, interspaces not so narrow as in *C. cognatus*, 3d, 5th and 7th moderately carinate; 9th carinate behind the middle. Beneath coarsely punctured; 5th ventral broadly impressed, mesosternum protuberant. Legs long, thighs unidentate, obsoletely annulated. Length 2.5 mm.; .10 inch.

Enterprise; one specimen. This is one of our smallest species.

138. **Conotrachelus coronatus,** n. sp.—Blackish, thinly clothed with very fine brownish-gray pubescence and scattered pale clavate bristles, with markings of dense fine white scales. Prothorax and elytra tuberculate; the former as long as wide, channeled, rough, with the sides straight, angulated and suddenly narrowed near the apex; there are four large apical tuberosities, and two discoidal ones, besides the lateral protuberance just mentioned; the anterior constriction is very deep and there is also a transverse impression behind the lateral and discoidal tuberosities; a narrow white vitta extends from apex to base each side mid-way between the dorsal channel and the sides; these lines are connected with others on the base of the 3d elytral interspace. Elytra sub-triangular, humeri prominent, rounded. Striæ composed of large punctures, interspaces wide, alternately interrupted with black tubercles bearing reclinate clavate bristles; at the base of the 3d interspace is a short white line; a large marginal spot, pointed interiorly behind the humerus, is also clothed with dense small white scales; behind the middle is a band composed of four small spots on the 1st to the 4th interspaces, and a small spot near the tip formed of pale scales. Legs long, thighs indistinctly annulated and sprinkled with white hairs, acutely unidentate. Under surface very coarsely punctured. Length 3 mm.; .12 inch.

Enterprise; one specimen. The head is coarsely cribrate; the beak bent beyond the middle, not longer than the head and prothorax, thicker than in any other species known to me, with deep broad striæ, and carinate along the median line. Antennæ situated near the end. The mesosternum is protuberant. This species belongs to Division II, of my arrangement, and should be placed before *C. tuberosus*, (Lec. Rhynch., 233), to which (apart from coloration) it has little resemblance. The femoral denticle is obsolete, but the tooth is acute and prominent.

139. **Acalles ventrosus,** n. sp.—Very obese, blackish, clothed with appressed gray and brown scales with intermixed clavate bristles. Head with the occiput clothed with yellowish-gray scales. Prothorax deeply and broadly channeled, twice as wide as long, rounded on the sides, uniform blackish brown. Elytra truncate at base, basal angles obtuse not rounded, sides obliquely widened, then rounded obliquely to the apex; there is a broad basal band occupying one-third the length of dirty gray scales, and some indistinct fasciate markings of the same color, behind the middle; the striæ are deeply impressed, and the interspaces moderately convex. Mesosternum broadly emarginate, as in *A. pectoralis* (Lec. Rhynch., 244). Legs clothed with dirt-colored scales. Length 4.3 mm.; .17 inch.

Enterprise; May, one specimen. More ventricose than any other species in my collection, and easily known by the deeply and broadly sulcate prothorax; the anterior transverse impression is broad and deep, and there is a broad discoidal impression each side near the base.

140. **Acalles subhispidus,** n. sp.—Blackish, densely clothed with dark scales, which are larger on the prothorax than on the elytra, where they are intermixed with short, reclinate bristles. Prothorax wide, strongly rounded on the sides in front, coarsely punctured, with a narrow, lateral line, and a few scattered scales pale dirt color; disc not carinate. Elytra but little wider than the prothorax, base truncate, basal angles obtuse, distinct, sides broadly rounded, then obliquely narrowed to the apex; very little wider behind the base, striæ coarsely punctured, interspaces slightly convex; there are traces of two narrow undulated bands, composed of small spots of gray scales, one before the middle, curving backwards towards the sides, the other behind the middle, curving forwards. Mesosternum deeply emarginate. Length 3.7 mm.; .15 inch.

Sumter County; May, one specimen. Easily known from our other species by the shorter reclinate bristles of the elytra. The prothorax is larger, and the elytra less rounded on the sides.

141. **Cryptorhynchus helvus,** n. sp.—Very similar to *C. obliquus* and differing only in the following characters: Scales pale yellow-brown, slightly variegated with darker; form of body a little narrower. Prothorax a little longer than wide, sides obliquely narrowed from the middle, where they are rounded to the apex, nearly parallel behind the middle. Elytra with the interspaces wide and flat. Thighs with one small acute tooth. Length 7.8 mm.; .31 inch.

Enterprise; May, one specimen. Except for the difference in the form of the prothorax, I should consider this as merely a variety of *C. obliquus*. The elytra are similarly impressed.

142. **Barilepton bivittatum,** n. sp.—Very elongate, black, shining, with a broad vitta of white scales each side, beginning at the front margin of the prothorax, and extending to the tip of the elytra. Head sparsely and finely punctured, beak curved, not as long as the prothorax, smooth. Prothorax wider than long, narrowed and rounded on the sides near the apex, where it is broadly and feebly constricted; disc strongly, not densely punctured, with an indistinct, narrow, smooth median line. Elytra with impunctured striæ, interspaces wide, flat, feebly and very finely punctulate. Beneath sparsely punctured; there is a patch of white scales on the flanks of the prothorax; the side pieces of the metasternum, and the sides of the ventral segments are also clothed with white scales;

the 3d and 4th ventral segments are nearly smooth. Prosternum with a wide, shallow, pectoral groove; tarsi brownish. Length 5 mm.; .20 inch.

Georgia and Northern Florida. For a specimen of this very handsome species, I am indebted to Dr. Horn.

143. **Sphenophorus apicalis,** n. sp. — Elongate, black, not shining. Prothorax with a narrow dorsal elevated line extending to the apex, where there is a large, oblong fovea on each side of it; discoidal elevations not apparent; punctures very large, shallow, irregularly scattered. Elytra with fine striæ, upon which are placed large, distant, rounded punctures; alternate interspaces slightly more convex near the base, which is deeply bifoveate, or trifoveate each side. Length 7 mm.; .23 inch.

Enterprise; May, one specimen. Belongs to Dr. Horn's Group V, (Proc. Am. Phil. Soc. 1873, 421), and may be placed in the table after *S. Sayi*, to which it is not allied. The proximal third of the beak is deeply and broadly excavated. The 3d joint of all the tarsi is narrow, and not spongy beneath.

144. **Mesites rufipennis,** n. sp.—Elongate, cylindrical, shining black, glabrous, antennæ and legs brown, elytra ferruginous. Head and dilated base of beak sparsely punctured, the former with a large, vertical fovea, the latter with a short, deep channel. Prothorax longer than wide, oblong, a little narrower in front, sides broadly rounded, more so at base and apex; surface strongly but not densely punctured. Elytra with striæ composed of approximate square punctures, interspaces not wider than the striæ, sparsely punctulate, the small punctures generally forming an irregular series on each interspace. Beneath coarsely punctured, ventral segments 1–4 sparsely and less coarsely punctured. Length 5.3 mm.; .21 inch.

♀ Beak slender, smooth; antennæ inserted just in front of the eyes. ♂ unknown.

New Smyrna; one specimen found on the ocean beach. This species is quite congeneric with *M. subcylindricus*, but differs by the red elytra, and more finely punctulate interspaces. The funiculus of the antennæ is stout, 7-jointed, and the 2d joint is not elongated. I therefore infer that they belong to the genus *Mesites* as restricted by Mr. Wollaston, and heretofore known only from Europe.

145. **Pityophthorus obliquus,** n. sp.—Cylindrical, not slender, dark-brown, shining, thinly clothed with fine, long, erect pubescence; antennæ and legs ferruginous. Head flat, opaque, indistinctly punctulate.

Prothorax quadrate, scarcely longer than wide, broadly rounded at apex, anterior one-fourth covered with obtuse granules, not arranged in concentric lines, gradually changing behind into fine, rugose, sparse punctuation. Elytra finely punctured, punctures arranged in approximate rows, which in places are indistinct; apical declivity flattened, feebly concave each side of the sutural stria, which is not very distinct; there are also traces at the apex of two other striæ. Front and middle tibiæ not toothed; hind tibiæ with a marginal row of 7 or 8 small acute spines, and a fringe of stiff long hairs. Length 2 mm.; .08 inch.

Enterprise; June, one specimen. This species may be placed after *P. digestus* Lec. (vide Rhynch. 352), but the flattened declivity of the elytra, only slightly concave near the suture, easily distinguishes it from all thus far described in our fauna. The punctures of the hinder part of the elytra are less fine than towards the base. The eyes are emarginate; the club of the antennæ is nearly circular, and transversely annulated.

146. **Pityophthorus seriatus,** n. sp.—Elongate, cylindrical, brown, shining, nearly glabrous, with only a few scattered, erect hairs on the head, front of prothorax, and hind part of elytra Antennæ and legs testaceous. Head flat, opaque, indistinctly punctulate, front feebly impressed, and indistinctly carinate. Prothorax quadrate, not longer than wide, rounded in front, anterior half with irregular, transverse, subconcentric rows of granules; sides and base sparsely but distinctly punctured. Elytra with striæ composed of small punctures, interspaces wider than the striæ, the alternate ones each with 4 or 5 distinct punctures of equal size with those of the striæ; declivity not flattened nor retuse, sutural stria slightly impressed. Length 1.5 mm.; .06 inch.

Tampa; April, one specimen. This species is quite distinct by the sculpture of the elytra, and may be placed before *P. comatus*, in the arrangement already cited. The front and middle tibiæ are not serrate, and the hind tibiæ have only 3 or 4 very indistinct traces of teeth, and no range of spines, or fringe of stiff hairs as in *P. obliquus*. This species has a deceptive resemblance to *Xyleborus pubescens*, but the generic characters of the antennal club are quite different, and the specific characters abundantly distinct.

147. **Cryphalus miles,** n. sp.—Very small, slender cylindrical, blackish, shining, clothed with short stout erect bristles. Prothorax a little longer than wide, apex produced into an acute spine; disc with a few acute reclinate granules in front, sparsely punctured behind. Elytra

strongly but not densely punctured, striæ hardly to be traced. Legs and antennæ piceous. Length .8 mm.; .035 inch.

Tampa; two specimens. Smaller and more slender than *C. rigidus* Lec. (Rhynch. 362), with much shorter bristles. The apical spine of the prothorax is a prolongation of the margin itself, and not a horn arising from the disc.

148. **Euxenus piceus,** n. sp.—Oval, rather elongate, convex, piceous, shining. Prothorax sparsely punctulate. Elytra punctured, the punctures forming indistinct striæ towards the sides; two outer striæ distinct, the outermost extending from the base for one-third the length; the inner one entire; marginal stria entire. Length .6 mm.; .025 inch.

Tampa, April 11th; one specimen. Differs from *Eu. punctatus* Lec. (Rhynch. 409), by the much smaller size, less distinctly punctured prothorax, and by the legs being not testaceous but dark, with only the tarsi yellowish. This insect has the appearance of a very minute *Crytocephalus*.

List of Species by E. A. SCHWARZ.

CICINDELIDÆ.

Tetracha carolina Linn. E. K. common in May and June, also attracted by the light.

virginica Linn. E. K. rare, with the preceding.

Cicindela scutellaris Say, race **unicolor** *Dej*.*

hirticollis Say, sea shore, as far as Key West.

dorsalis Say, NS. C. common on the sea beach; first specimen seen on April 4th; race *Saulcyi*; Key West, *var.* with elytra entirely white.

hamata Br. K. common in June on the ocean beach.

marginata Fabr. NS. C. K. common on the lagoon and ocean beach of the eastern coast; rare in April, common in June.

tortuosa Dej. common, first specimen seen on February 27th.

punctulata Fabr. common, appears about the beginning of May.

abdominalis Fabr. NS. E. K. common in the pine woods, appears in June; race with strongly punctured elytra.

striga Lec. L. E. very rare in May, nocturnal in its habits.

hirtilabris Lec. E. K. rare, in company with **C. abdominalis**.

gratiosa Guér.*

CARABIDÆ.

Omophron labiatum Fabr. common.
Pasimachus strenuus Lec. H. E. T. very rare.
sublævis Dej. rare.
marginatus Fabr. not rare.
subsulcatus Say, not rare.
Scarites substriatus Hald. T. rare.
subterraneus Fabr. common.
californicus Lec. K. very rare on the sea beach.
Dyschirius globulosus Say, C. H. T. not rare.
erythrocerus Lec. C. H. E. not rare.
filiformis Lec. C. H. rare.
falciger Lec. n. sp. p. 373, T. rare on the banks of the Hillsboro River.
Ardistomis obliquata Putz. not rare.
Schaumii Lec. common.
viridis Say, common.
puncticollis Putz. very rare.
Aspidoglossa subangulata Chd. not rare.
Clivina dentipes Dej. not rare.
rubicunda Lec. E. one specimen.
rufa Lec. E. rare.
americana Dej. not rare.
picea Putz. E. T. two specimens.
picipes Putz. E. L. K. very rare.
Schizogenius ferrugineus Putz. F. two specimens on the sea beach.
Sallei Putz. *var.* Lake Altapopka very rare.
Brachynus fumans Fabr.
quadripennis Dej.
cordicollis Dej.
lateralis Dej. common.
Panagæus crucigerus Say, H. L. very rare.
Morio monilicornis Latr. T. not rare, under old pine bark.
Helluomorpha præusta Dej. S. T. very rare, under old pine bark.
Galerita Janus Fabr. F. one specimen.
Lecontei Dej. C. S. E. not rare, found also on sugared trees.
Diaphorus Lecontei Dej. E. T. very rare, also attracted by the light.
Thalpius pygmæus Dej. very rare.
Casnonia ludoviciana Sallé, C. S. L. K. not rare.
Leptotrachelus dorsalis Fabr. C. very rare.
Ega Sallei Chevr. E. K. T. common.
Lachnophorus pubescens Dej. common.
Eucærus varicornis Lec. C. T. very rare.
Plochionus amandus Newman.*
timidus Hald. E. one specimen.
Bonfilsii Dej. *var.* NS. one specimen.

Loxopeza tricolor Say. T. rare.
Lebia pulchella Dej. C. T. rare.
    marginicollis Dej. not rare.
    viridis Say, E. L. NS. not rare.
    rhodopus Schwarz, n. sp. p. 354, T. rare.
    viridipennis Dej. C. E. K. not rare.
    lobulata Lec. E. rare.
    collaris Dej. T. E. rare.
    fuscata Dej.*
Dianchomena abdominalis Chd. E. one specimen.
    scapularis Dej. E. one specimen.
Aphelogenia furcata Lec. T. rare.
Nemotarsus elegans Lec.*
Tetragonoderus intersectus Germ. C. E. K. not rare.
Perigona nigriceps Dej. E. rare.
Apenes angustata Schwarz, n. sp. p. 354, E. rare.
    opaca Lec. T. in the pine woods under sticks, rare.
    sinuata Say. E. rare.
Pinacodera platicollis Say, *var.* **fuscata** Dej. H. E. rare.
Callida viridipennis Say, H. E. rare.
    fulgida Dej. C. H. E. rare.
    decora Fabr. E. very rare.
Onota trivittata Lec.* n. sp. p. 373, middle Florida.
Coptodera signata Dej. E. T. rare.
Platynus decorus Say, T. common.
    floridanus Lec. p. 374. Common.
    punctiformis Say, H. E. rare.
    octopunctatus Fab. T. one specimen.
Loxandrus reflexus Lec. n. sp., p. 376, C. E. K. T. common.
    calathinus Lec. n. sp., p. 376, T. not rare.
    floridanus Lec. n. sp., p. 376, C. T. E. common.
    erraticus Dej. E. very rare.
    celer Dej. C. E. rare.
    agilis Dej. common.
    velox Dej. not rare.
    rectangulus Lec. n. sp., p. 377, E. two specimens.
    crenatus Lec. not rare.
Evarthrus seximpressus Lec. E. K. rare.
    americanus Dej. one specimen, Polk county.
    obsoletus Say, T. in the pine woods under sticks rare.
    morio Dej. E. rare.
    faber Germ. T. very rare.
Pterostichus acutangulus Chd. C. T. very rare.
Lophoglossus tartaricus Say,* Northern Florida.
Badister flavipes Lec. C. E. T. rare.
    micans Lec. C. L. T. not rare.

Diplochila major Lec. common.
Dicælus quadratus Lec. K. very rare.
carinatus Dej. L. one specimen.
alternans Dej. L. E. T. very rare.
elongatus Dej. var.? E. very rare.
Chlænius herbaceus Chevr. C. S. L. T. rare.
erythropus Germ. not rare.
fuscicornis Dej. S. T. rare.
laticollis Say, common.
æstivus Say, E. rare.
augustus Newman*.
prasinus Dej. E. common.
nemoralis Say, rare.
tricolor Dej. common.
floridanus Horn, rare.
pensylvanicus Say, T. E. rare.
circumcinctus Say, C. E. T. rare.
maxillosus Horn, C. L. two specimens.
niger Rand. C. two specimens.
Anomoglossus emarginatus Say, T. one specimen.
Lachnocrepis parallelus Say, C. H. rare.
Anatrichis minuta Dej. C. K. T. rare.
Oodes americanus Dej. S. C. very rare.
amaroides Dej. C. E. T. not rare.
14-striatus Chd. rare.
Lecontei Chd. C. E. T. common.
cupræus Chd. C. two specimens.
Agonoderus infuscatus Dej. not rare.
testaceus Dej. common.
Anisodactylus merula Germ. not rare.
Anisotarsus agilis Dej. H. rare.
nitidipennis Lec. H. E. K. not rare.
Gynandropus hylacis var. **elongatus** Lec. C. T. very rare.
Selenophorus stigmosus E. not rare, frequently attracted by the light.
subtinctus Lec. C. S. very rare.
fossulatus Dej. C. Polk county, rare.
opalinus Lec. E. rare.
excisus Lec. n. sp. 377.
ovalis Dej. T. very rare.
Harpalus pensylvanicus DeG. not rare.
nitidulus Chd. H. E. rare.
Stenolophus spretus Dej. C. E. T. not rare.
plebejus Dej. T. one specimen.
ochropezus Say, E. rare.
Bembidium versicolor Lec. T. not rare.
contractum Say, common, especially on the sea beach.
affine Say.*

Tachys albipes Lec. C. S. E. T. rare.
ventricosus Lec. common.
lævis Say, common.
pallidus Chd. H. T. very rare.
columbiensis ┼ Zimm. ms. common.
nanus Gyll. common.
flavicauda Say, common.
ænescens Motsch. E. very rare.
xanthopus Dej. common.
incurvus Say, common.
granarius Dej. C. very rare.
carolinus ┼ Zimm. ms. common.
n. sp. E. very rare.

HALIPLIDÆ.

Haliplus punctatus Aubé, L. K. not rare.
Cnemidotus 12-punctatus Say, not rare.

DYTISCIDÆ.

Celina angustata Aubé, C. E. very rare.
grossula Lec. E. very rare.
Hydroporus exiguus Aubé, L. E. T. rare.
granum Lec. T. rare.
seminulum Lec. n. sp., p. 377, E. two specimens.
granarius Aubé,* Northern Florida.
affinis Say, *var.*? H. E. very rare.
fuscatus Cr. common.
inconspicuus Lec. not rare.
undulatus Say, common.
Hydrocanthus iricolor Say, L. T. not rare.
Suphis bicolor Say, L. T. not rare.
puncticollis Cr. E. two specimens.
n. sp. E. one specimen.
Colpius inflatus Lec. T. rare.
Cybister Olivieri Cr. NS. T. K. very rare.
Laccophilus proximus Say, common.
Thermonectes basilaris Harr. C. A. T. not rare.
Hydaticus bimarginatus Say, C. T. very rare.
Coptotomus interrogatus Fab. common.
Matus bicarinatus Say.*
Copelatus glyphicus Say, common.
Chevrolatii Aubé, C. T. rare.

GYRINIDÆ.

Dineutes carolinus Lec. C. S. not rare.
serrulatus Lec. S. E. A
angustus Lec.* n. sp. p 378.

Gyrinus elevatus Lec. common.
Rockinghamensis Lec.*

HYDROPHILIDÆ.

Hydrochus rugosus Muls. E. T. rare. **callosus** Lec.*
inæqualis Lec. common.
three unnamed species.
Ochthebius attritus Lec. n. sp., p. 380, H. one specimen on the lagoon beach.
simplex Lec. n. sp., p. 380, H. one specimen with the preceding.
foveicollis Lec. n. sp., p. 381, H. E. not rare.
Hydræna marginicollis Kiesenw. rare.
Tropisternus lateralis Fabr. common.
striolatus Lec. E. not rare.
glaber Hbst. common.
Hydrocharis castus Say, C. very rare.
Berosus pugnax Lec. E. one specimen.
aculeatus Lec. L. not rare.
peregrinus Hbst.*
exiguus Say, E. A. K. not rare.
infuscatus Lec. L. E. not rare.
striatus Say, C. T. rare.
Chætarthria pallida Lec. C. S. E. not rare.
Philhydrus nebulosus Say, common.
bifidus Lec. E. Orange County, rare.
ochraceus Melsh. common.
consors Lec. C. P. T. rare.
diffusus Lec. C. common.
perplexus Lec. common.
Hydrobius subcupreus Say, common.
suturalis Lec. E. K. T. very rare.
despectus Lec. H. rare.
Cyclonotum palmarum Schwarz, n. sp. p. 355, E. rare.
estriatum Say, common.
semiglobosum Zimm. common.
Cercyon prætextatum Say, common.
ocellatum Say, C. E. not rare.
sp. C. E. not rare.

TRICHOPTERYGIDÆ.

Nossidium americanum Mots. T. under old leaves, rare.
Ptenidium atomaroides Mots. common in salt marsh on the eastern coast.
Ptilium three unnamed species.
Nephanes læviusculus Matth. E. under old leaves rare.
? **Smicrus** two species.

Trichopteryx five unnamed species.
Limulodes paradoxus Matth.*
Ptinellodes Lecontei Matth. T. under pine bark, rare.
Ptinella pini Lec. T. under pine bark, rare.
nigrovittis Lec. T. under pine bark, very rare.

STAPHYLINIDÆ.

Falagria cingulata Lec. E. rare.
partita Lec.*
venustula Er. S. two specimens.
4 other species apparently undescribed.
Hoplandria pulchra Kraatz, shores of Indian Riv. common.
two other species.
Homalota plana Gyllh. T. under pine bark, not rare.
about 30 other species.
? **Stenusa** two species under pine bark.
Placusa despecta Er. T. beaten from dead pine leaves, rare.
Philotermes n. sp. E. one specimen under old leaves.
Aleochara brachyptera Fourc. E. not rare.
nitida Grav. common.
Oxypoda three or four species.
Oligota four species.
Gyrophæna six unnamed species.
Myllæna four unnamed species.
Dinopsis myllænoides Kraatz, C. T. very rare.
n. sp. P. E. T. very rare.
A number of other **Aleocharini.**
Anacyptus testaceus Lec. S. NS. under old pine bark, very rare.
Tachinus fumipennis Say.*
Erchomus ventriculus Say, common, under bark.
lævis Lec. common in wet places under old leaves.
Conosoma crassum Grav. T. rare.
basale Er. E. not rare.
pubescens Payk. C.
opicum Say, common.
scriptum Horn, T. one specimen.
Bryoporus rufescens Lec. common.
var. **testaceus** Lec. common.
Mycetoporus lepidus Er. T. rare.
flavicollis Lec. common.
Acylophorus pronus Er. E. T. not rare.
densus Lec. n. sp. p. 387, E. two specimens.
flavipes Lec. n. sp. p. 387, C. very rare; (occurs also in Ohio).
Tanygnathus collaris Er. S. P. E. rare in very wet places.
Quedius ferox Lec. n. sp. p. 388, E. one specimen; (occurs also at Cambridge, Mass).

Creophilus villosus Grav. common.
Staphylinus comes Lec. T. one specimen.
tomentosus Grav. C. H. E. rare.
cicatricosus Lec.
one unnamed species T.
Belonuchus formosus Grav. common.
Philonthus hepaticus Er. E. common.
micans Grav. E. T. rare.
pæderoides Lec. common.
bistriatus Er. NS. C. on the sea beach, very rare,
and four unnamed species.
Xantholinus emmesus Grav. S. T. under bark, not rare.
cephalus Say, T. under pine bark, rare.
two unnamed species.
Leptacinus flavipes Lec E. rare.
n. sp. T. E. rare.
nigripennis Lec. E. New Smyrna, rare.
Diochus Schaumii Kraatz, *var.* common.
Lathrobium puctulatum Lec. C. E. rare.
dimidiatum Say, not rare.
four unnamed species.
Cryptobium bicolor Grav. common.
floridanum Lec. n. sp. p. 389, E. one specimen.
latebricola Nordm. K. T. rare.
lugubre Lec. n. sp. p. 393, T. E. rare.
obliquum Lec. n. sp. p. 394, T. not rare.
parcum Lec. n. sp. p. 394, K. very rare.
Stilicus angularis Er. E. not rare.
Scopæus opacus Lec. common.
exiguus Er. N. S. E. rare.
two unnamed species.
Echiaster Sallei † Fvl. E.
Lithocharis corticina Grav. not rare.
four unnamed species.
Dacnochilus angularis Er. E. K. two specimens.
Sunius monstrosus Lec. T. E. very rare.
linearis Er. not rare.
prolixus Er. common.
binotatus Say, common.
Stilicopsis paradoxa Sachse, H. E. very rare.
Pæderus littoreus Zimm. T. very rare.
floridanus Austin, common.
obliteratus Lec.* n. sp. p. 395, Southern Florida.
Pinophilus picipes Er. H. very rare.
latipes Er. T. two specimens.
parcus Lec. S. E. rare.
opacus Lec. not rare.

Palaminus flavipennis Lec. n. sp. p. 396, common.
  contortus Lec. n. sp. p. 397, T. E. S. common (occurs also in Michigan).
  cribratus Lec. n. sp. p. 397, very rare.
  pumilus Lec. n. sp. p. 398, T. E. rare.
  larvalis Lec. very rare.
Stenus colonus Er. not rare.
  arculus Er. E. C. T. rare.
  callosus Er. S. E. rare.
  and five undescribed species.
Euæsthetus two undescribed species.
Megalops cælatus Grav. E. T. two specimens, lives on fungus which grows on the underside of old logs.
Osorius politus Lec. Hilsboro Co. very rare in May and June.
  latipes Grav. C. E. T. not rare, frequently beaten from trees and shrubs.
  n. sp.? T. rare.
Holotrochus minor Fauvel, E. K. very rare in June on flowers.
Bledius mandibularis Er. S. one specimen.
  politus Er. T. one specimen.
  fumatus Lec. C. S. two specimens.
  cognatus Lec. E. not rare, attracted by the light.
  semiferrugineus Lec. C. rare.
  basalis Lec. E. K. common.
  dimidiatus Lec. E. Lake Altapopka, rare.
  cordatus Say, abundant on sea shore.
Oxytelus incolumis Er. S. T. very rare.
  sculptus Grav.*
  convergens Lec. Sand Point, two specimens.
  insignitus Grav. common.
  exiguus Er. T. E. rare.
Apocellus sphæricollis Say, common.
  stilicoides Lec. F. E. very rare.
Trogophloeus memnonius Er. (fide Fauvel) Sand point, C. common on the lagoon beach.
  fulvipes Er. common.
  six unnamed species.
Glyptoma costale Er. E. rare.
Ancæus rufescens Lec. F. E. very rare, lives in the galleries of **Mallodon dasystomus**.
Lispinus tenuis Lec. T. under pine bark, rare.

PSELAPHIDÆ.

Tmesiphorus costalis Lec. P. one specimen.
  carinatus Say, T. under old pine bark, not rare.
Ctenistes piceus Lec. not rare.
  Zimmermanni Lec. T. E. rare.

Rhinoscepsis bistriata Lec. n. g. and sp. p. 382, T. E. under old leaves, rare.
Tychus longipalpus Lec. T. E. rare.
Bryaxis dentata Say, C. H. E. rare.
floridana Brend. H. S. rare.
puncticollis Lec. common.
n. sp. C. H. E. rare.
rubicunda Aub.? T. E. not rare.
Decarthron abnorme Lec. E. one specimen.
exsectum Brend. C. S. T. rare.
formiceti Lec. rare.
n. sp. T. rare.
Eupsenius glaber Lec. E. T. rare.
rufus Lec. T. one specimen.
Arthmius globicollis Lec. common.
Rhexius insculptus Lec. E. T. very rare.
substriatus Lec. n. sp. p. 383. T. one specimen under old leaves.
Trimium convexulum Lec. n. sp. p. 383, T. rare.
simplex Lec. n. sp. p. 384, T. one specimen.
Euplectus linearis Lec. F. two specimens.
interruptus Lec. F. E. C. rare.
debilis Lec. n. sp. p. 386, T. rare, on swampy meadows at sunset.
tenuis Lec. n. sp. p. 386, C. one specimen.
ruficeps Lec. T. rare.
cavicollis Lec. n. sp. p. 387, T. rare.

SILPHIDÆ.

Necrophorus carolinus Linn. E. rare.
orbicollis Say, common.
Silpha inæqualis Fabr. common.
americana Linn. common.
Ptomaphagus oblitus Lec. E. very rare.
consobrinus Lec. var.
Lecontei Murray, S. E. very rare.
Anogdus capitatus Lec.* Middle Florida.
Cyrtusa blandissima Zimm. T. one specimen.
Colenis impunctata Lec. E. T. not rare.
Clambus gibbulus Lec. E. rare.

SCYDMÆNIDÆ.

Microstemma grossa Lec. H. E. T. rare.
Motschulskii Lec. common.
Scydmænus magister Lec. common.
fossiger Lec. C. rare.
capillosulus Lec. common.
basalis Lec. C. H. E. rare.
divisus Schwarz, n. sp. p. 357, E. rare.

Scydmænus analis Lec. E. very rare.
brevicornis Say, S. E. very rare.
pyramidalis Lec. H. E. two specimens.
clavipes Say, C. H. E. not rare.
fatuus Lec. E. rare.
five undescribed species.
Chevrolatia amœna Lec. T. one specimen under old leaves.

CORYLOPHIDÆ.

Rhypobius marinus Lec. common under old leaves.
Orthoperus glaber Lec. common on grasses and shrubs.
Corylophus marginicollis Lec. common.
Sericoderus subtilis Lec. common.
Sacium lunatum Lec. E. very rare.
mollinum Schwarz, n. sp. p. 356, T. E. common, lives on the yellow pine.
splendens Schwarz, n. sp. p. 358, not rare, lives on dead leaves of the yellow pine.

SCAPHIDIIDÆ.

Cyparium flavipes Lec. E. T. two specimens.
Scaphisoma convexum Say, E. T. very rare.
punctulatum Lec. E. not rare.
terminatum Melsh. E. common.
pusillum Lec. E. T. not rare.
n. sp. E. rare.
Toxidium gammaroides Lec. E. rare.
compressum Zimm.*

LATHRIDIIDÆ.

Corticaria deleta Mann. common.
pumila Mels. common.
picta Lec. common.
simplex Lec. T. very rare.
three undescribed species.

DERMESTIDÆ.

Dermestes nubilus Say, common.
elongatus Lec. H. one specimen.
cadaverinus Fabr.* Southern Florida.
maculatus DeG. E. T. rare.
Cryptorhopalum ruficorne Lec. NS. E. rare.
hæmorrhoidale Lec.* Northern Florida.
Orphilus glabratus Er. *race* **ater** Er. T. one specimen.

ENDOMYCHIDÆ.

Epipocus punctatus Lec. T. E. rare, lives under old pine bark.
Stenotarsus hispidus Hbst. E. one specimen.

Rhymbus Ulkei Cr. E. rare, lives on fungus, which grows on dead branches.
Anamorphus pusillus ↓ Zimm. ms. E. rare with the preceding.*

MYCETOPHAGIDÆ.

Litargus tetraspilotus Lec. NS. rare, beaten from pine trees.
sexpunctatus Say, E. not rare.
infulatus Lec. E. rare.
nebulosus Lec. *var.?* common under old leaves.
Typhæa fumata Linn. common.

SPHINDIDÆ.

Sphindus americanus Lec. F. H. E. not rare.

CIOIDÆ.

Cis creberrimus Mell. E. rare.
eight unnamed species.
Ennearthron two unnamed species.

EROTYLIDÆ.

Languria discoidea Lec. not rare, lives on a species of *Carduus*.
marginipennis Schwarz, n. sp. p. 357, C. T. E. very rare.
Megalodacne fasciata Fab. E. rare.
heros Say, E. rare.
Ischyrus 4-punctatus Oliv. E. not rare.
nigrans Cr.*
Cyrtotriplax angulata Say, B. E. not rare.
unicolor Say, B. rare.
affinis Lec. B. E. not rare.
Triplax thoracica Say, E. common.

CRYPTOPHAGIDÆ.

Loberus impressus Lec. C. H. E. rare.
Cryptophagus sp. T. one specimen.
Tomarus hirtellus Schwarz, n. sp. p. 358, common under old leaves.
Marginus rudis Lec. H. E. T. not rare under oak bark.
Silvanus advena Waltl, common.
surinamensis Linn. E. rare.
bidentatus Fabr. common.
rectus Lec. common under old leaves.
quadricollis Guér. rare under oak bark.
Nausibius dentatus Mels. L. rare under old oak bark.
repandus Lec. T. very rare under oak bark.

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* I have not described this genus, as its affinities are not yet clearly made out. It is a small rounded testaceous hairy insect, having somewhat the aspect of *Rhymbus*, but without prothoracic lines; the tarsi are not dilated. The specimens at my disposal are not sufficient for a thorough investigation. LEC.

CUCUJIDÆ.

Catogenus rufus Fabr. not rare.

Lathropus pictus Schwarz, n. sp. p, 358, H. very rare, under old bark of *Quercus virens*.

Læmophlœus biguttatus Say, H. E. T. rare.

fasciatus Mels. E. T. not rare.

chamæropis Schwarz, n. sp. p. 359, E. very rare.

modestus Say, common.

two unnamed species.

Nemicelus marginipennis Lec. common on *Chamærops palmetto*, also attracted by the light.

microphthalmus Schwarz, n. sp. p. 360, T. E. two specimens.

COLYDIIDÆ.

Ditoma carinata Lec. T. E. two specimens.

4-guttata Say, common.

Synchita granulata Say, common.

nigripennis Lec. E. T. rare.

Cicones lineaticollis Horn, n. sp. C. E. two specimens; (will be described in a subsequent paper).

Lasconotus pusillus Lec. P. T. common, under pine bark in the galleries of *Scolytidæ*.

referendarius Zimm. T. not rare with the preceding.

Aulonium ferrugineum Lec. T. rare under pine bark.

Colydium lineola Say, C. H. E. rare under oak and hickory bark.

Eulachus carinatus Lec. E. very rare in cut down palmetto trees.

Nematidium mustela Pascoe, C. E. very rare under hickory bark.

Sosylus costatus Lec. C. E. very rare with the preceding.

Endectus hæmatodes Fab. common under old pine bark.

reflexus Say, T. very rare with the preceding.

Philothermus puberulus Schwarz, n. sp. p. 361, common under old pine bark.

MONOTOMIDÆ.

Bactridium striolatum Reitter, E. T. very rare.

Europs pallipennis Lec. E. T. very rare in rotten oranges.

Monotoma producta Lec. K. very rare under pine bark.

Monotoma americanum Aubé, E. rare under old leaves.

Smicrips palmicola Lec. n.g. and sp. p. 399, common in fermenting juice of palmetto trees, in rotten oranges, &c.; found also at Savannah, Ga.

TROGOSITIDÆ.

Nemosoma cylindricum Lec. T. rare, beaten from dead pine leaves.

Trogosita virescens Fabr. E. T. not rare with the preceding.

Alindria cylindrica Serv. S. T. very rare under pine bark.

Tenebrioides cucujiformis Horn C. rare.

castanea Mels. E. T. not rare.

semicylindrica Horn E. rare.

NITIDULIDÆ.

Colastus maculatus Er. E. one specimen.
morio Er. E. rare in the fermenting juice of palmetto trees.
semitectus Say, E. one specimen.
unicolor Say, T. not rare on pine trees.
truncatus Rand. common.
Conotelus obscurus Er. C. not rare in the blossoms of *Convolvulus*.
Brachypeplus glaber Lec. n. sp. p. 398, E. two specimens.
Carpophilus ferrugineus Murr. H. E. rare.
pallipennis Say. common in the blossoms of *Cactus*.
ferrugineus Murr. common.
melanopterus Er.* on *Yucca gloriosa*.
luridus Murr. E. T. not rare.
Epuræa labilis Er.? C. E. not rare.
luteola Er. common.
Prometopia 6-maculata Say, E. rare.
Lobiopa undulata Say, L. rare.
Omosita colon Linn. common.
Stelidota geminata Say, C. E. rare.
8-maculata Say, E. very rare.
strigosa Schœnh. not rare.
Amphicrossus ciliatus Ol. E. not rare.
Pallodes silaceus Er. E. common in fungi.
Cybocephalus nigritulus Lec. T. one specimen.
Ips sanguinolentus Ol.*

PHALACRIDÆ.

Phalacrus politus Melsh. NS. E. T. rare.
pumilio Lec.? E. one specimen.
n. sp. common.
Olibrus bicolor Gyllh. E. K. T. rare.
rubens Lec. H. E. very rare.
princeps Schwarz, n. sp. p. 361, NS. E. two specimens.
consimilis Melsh. common.
nitidus Melsh. common.
pusillus Lec. common.
several unnamed and undescribed species.
Litochrus pulchellus Lec. rare on oak shrubs.

COCCINELLIDÆ.

Megilla maculata DeG. *var* common.
Coccinella affinis Rand *var*. T. very rare on willows.
Cycloneda sanguinea Linn. common.
Psyllobora nana Muls. common on oak shrubs.
Chilocorus bivulnerus Muls. E. C. rare.
Exochomus tripustulatus DeG. NS. E. rare.
marginipennis Lec. E. common, lives on the cypress.
contristatus Muls. common on oak shrubs.

Brachyacantha dentipes Fab. T. rare.
  querceti Schwarz, n. sp. p. 362, common on oak shrubs.
Hyperaspis fimbriolata Melsh. C. one specimen.
  proba Say, very rare.
  bigeminata Rand. H. E. not rare.
  paludicola Schwarz, n. sp. p. 362, common on swampy meadows.
  two undescribed species.
Hyperaspidius militaris Lec. rare on oak shrubs.
Scymnus balteatus Lec. n. sp. p. 399, S. two specimens.
  quadritæniatus Lec. n. sp. p. 400, E. C. rare on oak shrubs.
  bioculatus Muls. H. NS. very rare.
  xanthaspis Muls. NS. T. rare.
  terminatus Say, common.
  ochroderus Muls. not rare.
  cervicalis Muls. common.
  several undescribed species.
Cephaloscymnus Zimmermanni Cr. E. very rare
Pentilia misella Lec. n. sp. p. 400, T. rare.
  ovalis Lec. n. sp. p. 400, E. H. rare.
Œneis pallida Lec. n. sp. p. 400, Sand Point, rare.
  pusilla Lec. S. very rare.

BYRRHIDÆ.

Limnichus obscurus Lec. E. common.
  ater Lec. E. common.
  nitidulus Lec. E. very rare.
  ovatus Lec. common.

PARNIDÆ.

Pelonomus obscurus Lec. E. common.
Stenelmis bicarinatus Lec. T. one specimen.

HETEROCERIDÆ.

Heterocerus collaris Kw. E. not rare.
  two unnamed species.

HISTERIDÆ.

Hololepta quadridentata Fab. common, lives in *Chamærops palmetto.*
Hister lævipes Germ. C. H. rare.
  cœnosus Er. Northern Florida, common.
  abbreviatus Fab. common.
  depurator Say, common.
  incertus Mars. E. T. very rare.
  indistinctus Say, H. one specimen.
  americanus Payk. E. T. common.
  subrotundus Say, K. one specimen.

(Platysoma) **carolinus** Payk. common.
parallelus Say, T. not rare.
cylindricus Payk. T. under pine bark, not rare.
attenuatus Lec. T. one specimen.
Epierus regularis Beauv. P. E. S. common under old leaves.
pulicarius Er. common under bark.
brunnipennis Mars. H. E. T. common under old leaves.
Paromalus seminulum P. E. rare under pine bark.
Tribalus americanus Lec. T. rare under old pine bark.
Saprinus Floridæ Horn, E. one specimen.
pensylvanicus Payk. common.
assimilis Payk. C. H. E. common.
cubæcola Mars.*
conformis Lec. E. one specimen.
placidus Er. E. T. rare.
neglectus Mars. H. K. one specimen.
sphæroides Lec. E. one specimen.
ferrugineus Mars. common.
dentipes Mars.* *vide* p. 401, Southern Florida.
brasiliensis Payk.* *vide* p. 401, Southern Florida.
permixtus Lec. n. sp. p. 401, K. not rare on the sea beach.
Plegaderus Barbelini Mars. P. T. rare.
transversus Say, P. T. rare.
Bacanius misellus Lec. P. E. rare.
punctiformis Lec. common.
Acritus exiguus Er. P. very rare.
Floridæ Mars.*
salinus Lec. n. sp. p. 402, K. not rare on the sea beach.
Æletes simplex Lec. E. rare in *Chamærops palmetto*.

LUCANIDÆ.

Passalus cornutus Fabr. common.

SCARABÆIDÆ.

Canthon nigricornis Say, not rare.
probus Germ. E. one specimen.
depressipennis Lec. T. rare.
viridis Beauv. E. rare.
hudsonias Forst. common.
Deltachilum gibbosum Fabr. C. S. E. rare.
Chœridium Lecontei Harold, C. E. not rare.
Copris anaglypticus Say, common.
minutus Drury, common.
Phanæus carnifex Linn. common.
nigrocyaneus McL. common.
Onthophagus Hecate Panz. common.

Onthophagus Janus *var.* **Orpheus** Panz. E. one specimen.
tuberculifrons Harold, common.
pensylvanicus Harold, T. rare.
Aphodius crassulus Horn.*
ruricola Melsh. C. not rare.
lividus Oliv. C. very rare.
vestiarius Horn, common.
rubeolus Beauv. common.
one new species.*
Atænius imbricatus Melsh. common.
sculptilis Harold, E. one specimen.
alternatus Melsh. common.
gracilis Melsh. common.
ovatulus Horn, E. very rare.
stercorator Fab. common.
abditus Hald. C. H. E. not rare.
cylindrus Horn, common.
Euparia castanea Serv. F. one specimen among ants.
Psammodius bidens Horn, C. NS. K. T. rare on the sea beach.
Ochodæus frontalis Lec. E. one specimen.
Bradycinetus ferrugineus Beauv. E. two specimens.
Bolboceras Lazarus Fabr. H. E. K. not rare, attracted by the light.
Odontæus filicornis Say, E. one specimen.
Geotrupes splendidus Fabr. *var.?* E. only a fragment of one elytron found.
chalybæus Lec. n. sp. p. 402, T. one fragmentary specimen.
Acanthocerus æneus McLeay, E. rare, beaten from dead vines.
Clœotus aphodioides Ill. E. rare.
globosus Say, E. rare.
Trox scabrosus Beauv. not rare.
suberosus Fabr. common.
terrestris Say, not rare.
Hoplia mucorea Germ. S. one specimen in February.
Serica vespertina Schh. H. T. rare in February and April.
Hypotrichia spissipes Lec.*
Diplotaxis subcostata Blanch. K. one specimen in June.
bidentata Lec. E. K. T. common in March and April.
languida Lec. n. sp. p. 403, T. common in April, on oak trees, at night.
Lachnosterna latifrons Lec. E. K. not rare in May and June.
cerasina Lec. C. one specimen in April.
glaberrima Lec. C. rare in April.
micans Kn. T. common in April.
fraterna Harr. E. very rare in May.
tristis Fabr. H. very rare in March.
four undescribed species.
Polyphylla occidentalis Linn. T. rare on young pine trees in April.

Anomala varians Fabr. common.
minuta Burm. C. S. E. rare.
marginata Fabr. C. E. T. not rare in May and June.
semilivida Lec. n. sp. p. 403, C. T. common in March and April in the pine woods; flies shortly before sunset.
Strigoderma pygmæa Fabr. T. common in April.
exigua Schwarz, n. sp. p. 362, Sumter Co. very rare in May.
Pelidnota punctata Linn. E. common in May.
Cyclocephala immaculata Burm. common.
puberula Lec. T. very rare.
Chalepus trachypygus Burm. common.
Ligyrus gibbosus DeG. C. common.
Aphonus castaneus Melsh. C. E. rare.
Polymœchus brevipes Lec. E. rare.
Strategus Antæus Fabr. not rare.
splendens Beauv. T. very rare.
Dynastes Tityus Linn. E. rare.
Phileurus truncatus Beauv. E. one specimen in June.
valgus Fabr. T. E. rare.
Euryomia melancholica Grav. common.
inda Linn. rare.
fulgida Fabr. *var.* E. common.
Cremastochilus Harrisii Kby. C. L. T. rare.
squamulosus Lec.*
Gnorimus maculosus Kn. K. one specimen.
Trichius piger Fabr. common.
texanus Horn.*
viridulus Fab. E. rare.
delta Forst. E. NS. common.

BUPRESTIDÆ.

Chalcophora virginiensis Drury, S. T. rare.
georgiana Lec.*
Dicerca obscura Fab. common.
Buprestis rufipes Ol. E. not rare in oak trees.
lineata Fab. C. T. rare.
Anthaxia viridicornis Say, *var.?* T. two specimens.
quercata Fabr. T. one specimen.
flavimana Gory, T. one specimen.
Chrysobothris femorata Lec. common.
floricola Gory, T. rare.
dentipes Germ. common.
chrysoela Ill. H. E. A. very rare.
one unnamed species (**femorata** *var.?*)
Actenodes auronotata Lap. C. one specimen in April.
calcarata Chevr. E. very rare in June.

Acmæodera pulchella Hbst. not rare.
  culta Web. T. rare.
Rhæboscelis tenuis Lec. E. K. very rare.
Agrilus ruficollis Fabr. C. T. not rare.
  vittaticollis Rand. E. one specimen.
  floridanus Cr. T. rare.
  imbellis Cr. T. NS. not rare.
Taphrocerus puncticollis Schwarz, n. sp. p. 363, C. K. T. very rare.
  gracilis Say, common.
  agriloides Cr. H. very rare.
  lævicollis Lec. n. sp. p. 403, E. one specimen.
Brachys ovata Web. common.
  fascifera Schwarz, n. sp. p. 363, not rare on *Quercus virens*.
  tesselata Fabr. T. very rare.
Pachyscelus cæruleus Schwarz, n. sp. p. 364, common.

THROSCIDÆ.

Throscus constrictor Say, T. one specimen.
  punctatus Bonv. T. rare.
  two undescribed species.
Drapetes geminatus Say, E. very rare.
  4-pustulatus Bonv. T. very rare under old pine bark.
  rubricollis Lec. E. NS. T. rare on blossoms of *Chamærops palmetto*.

ELATERIDÆ.

Deltametopus amœnicornis Say, E.
Fornax badius Mels. E. one specimen.
  bicolor Mels. E. one specimen.
  molestus Bouv. E. one specimen.
Dromæolus striatus Lec. K. one specimen.
Microrhagus mucidus Bonv. E. very rare.
Nematodes punctatus Lec. n. sp. E. p. 404, E. one specimen.
Anelastes Drurii Kby. common in the pine woods.
Agrypnus Sallei Lec. L. T. rare.
Adelocera marmorata Say, E. very rare.
  avita Say, E. very rare in decaying oak trees.
Lacon rectangularis Say, common.
Alaus oculatus Linn. common.
  myops Fabr. not rare.
Hemirhipus fascicularis Fab. E. one specimen.
Cardiophorus cardisce Say? NS. H. very rare on the sea beach.
  Dejeanii Lec. F. K. very rare.
  gagates Er. H. S. not rare.
  Floridæ Cand. NS. E. very rare.
  one undescribed species.

Horistonotus Uhlerii Horn, NS. rare.
Esthesopus bicolor Horn, E. very rare, lives in decaying oak logs.
Elater fuscatus Melsh. E. T. very rare under pine bark.
one unnamed species.
Drasterius elegans Fabr. H. E. very rare.
Megapenthes Sturmii Germ. E. one specimen.
Anchastus longulus Lec. n. sp. p. 404, C. E. not rare.
binus Say, E. very rare.
fuscus Lec. n. sp. p. 404, E. very rare.
asper Lec. n. sp. p. 404, E. not rare.
Monocrepidius lividus DeG. common.
suturalis Lec. E. T. very rare.
lepidus Lec. C. T. rare.
vespertinus Fabr. C. NS. E. not rare.
auritus Hbst. C. rare.
bellus Say, common.
blandulus Lec. C. S. T. rare.
Dicrepidius ramicornis Beauv. T. one specimen under old pine bark.
Orthostethus infuscatus Germ. E. rare.
Crigmus hepaticus Germ. K. E. not rare on sugared trees and attracted by the light.
Glyphonyx recticollis Say, common.
testaceus Melsh. common.
Melanotus clandestinus Er. common.
communis Gyll. common.
parumpunctatus Mels. not rare.
dubius Lec. H. common.
tenellus Er. H. T. rare.
three unnamed species.
Pityobius anguinus Lec. S. E. two specimens.
Athous debilis Lec. n. sp. p. 405, L. one specimen.
cucullatus Say. common.
Sericosomus silaceus Say, H. rare.
Pyrophorus physoderus Germ. NS. E. K. not rare in June.
Anachilus mandibularis Lec.* Middle Florida.
Cebrio bicolor S. E. Orange County, rare.

RHIPICERIDÆ.

Zenoa picea Beauv. E. very rare.
Sandalus petrophya Kn. C. T. rare.

DASCYLLIDÆ.

Cyphon punctatus Lec. A. rare.
modestes Lec. common.
impressus Lec. n. sp. p. 405, T. E. rare, on swampy meadows.
Ptilodactyla serricollis Say, common.
elaterina Guér. common.

LAMPYRIDÆ.

Lycus lateralis Mels. C. E. rare.
Calopterum typicum Newm. E. T. rare.
Cænia basalis Lec. E. rare.
Eros trilineatus Mels. not rare.
  modestus Say, common.
  canaliculatus Say, common.
  two undetermined species.
Lucidota atra Fabr. E. one specimen.
  luteicollis Lec. n. sp. p. 405, T. Sumter and Orange Cos., rare.
Photinus minutus Lec. common.
  angulatus Say, C. T. rare.
  ecostatus Lec.* n. sp. 406, Key West.
  lucifer Melsh. H. C. rare.
  nitidiventris Lec. n. sp. p. 406, E. C. very rare.
  consanguineus Lec. common.
  lineellus Lec. common.
  collustrans Lec. n. sp. p. 407, T. E. one specimen.
  umbratus Lec. n. sp. p. 407, B. C. T. H. rare.
Photuris pensylvanica DeG. common.
  frontalis Lec. H. not rare.
Phengodes plumosa Oliv. H. very rare.

TELEPHORIDÆ.

Chauliognathus marginatus Fabr. common.
Podabrus rugosulus Lec. T. rare.
Telephorus imbecillis Lec. *var.?* T. very rare.
  n. sp. E. rare.
(Polemius) **incisus** Lec. C. E. not rare.
  two undescribed species.
Lobetus abdominalis Lec. common on swampy meadows in June.
Malthinus difficilis Lec. T. one specimen.

MALACHIIDÆ.

Collops nigriceps Say, common.
Temnopsophus bimaculatus Horn, common.
  impressus Schwarz, n. sp. p. 364, A. rare in June.
Pseudebæus apicalis Say, E. T. very rare.
Attalus morulus Lec. Baldwin, rare.
  circumscriptus Say, common.
  scincetus Say, rare.

CLERIDÆ.

Priocera castanea Newm. C. T. rare under pine bark.
Trichodes apivorus Germ. E. T. rare.

Clerus rosmarus Say, T. very rare.
lunatus Spin. C. H. T. rare.
ichneumoneus Fabr. H. very rare.
thoracicus Oliv. H. T. rare.
Hydnocera rufipes Newm. T. two specimens on oak shrubs.
suturalis Klug. E. one specimen.
ægra Newm. rare on swampy meadows.
Chariessa pilosa Forst. C. E. T. rare.
Cregya vetusta Spin. E. very rare.
oculata Say, T. one specimen.
Orthopleura damicornis Fabr. C. H. E. rare.
Corynetes rufipes Fabr. H. E. rare.

PTINIDÆ.

Mezium americanum Lap. T. one specimen.
Ernobius granulatus Lec. T. not rare on pine trees.
Ozognathus floridanus Lec. n. sp. p. 408, T. two specimens.
Nicobium hirtum Ill. A. one specimen.
Trypopitys sericeus Say, E. one specimen.
Petalium bistriatum Say, common.
Eupactus viticola Schwarz, n. sp. p. 335, E. rare in June.
Catorama punctulata Lec. n. sp. p. 409, T. very rare.
holosericea Lec. n. sp. p. 409, E. rare, beaten from dead vines.
minuta Lec. n. sp. p. 409, E. rare, beaten from dead vines.
Hemiptychus gravis C. E. T rare, on oak shrubs.
debilis Lec. n. sp. p. 408, E. very rare on oak shrubs.
similis Lec. n. sp. p. 408, T. rare on oak shrubs.
puberulus Lec. n. sp. C. rare on oak shrubs.
abbreviatus Lec. n. sp. p. 408, C. rare on oak shrubs.
auctus Lec. n. sp. p. 409, C. rare on oak shrubs.
nigritulus Lec. H. T. rare on oak shrubs.
Dorcatoma granum Lec. n. sp. p. 411, E. very rare on old twigs.
Cænocara oculata Say, common.
lateralis Lec. n. sp. p. 411, E. two specimens.
Byrrhodes setosus Lec. n. g. and sp. p. 413. C. one specimen.
Tetrapriocera Schwarzi Horn, n. g. and sp. C. very rare, two specimens.
Sinoxylon basilare Say, E. rare.
Bostrychus bicornis Web. E. rare.
Amphicerus bicaudatus Say, H. rare.
Dinoderus porcatus Lec. T. rare on pine trees.

SPONDYLIDÆ.

Scaphinus sphæricollis Lec. Lake Altapopka, one specimen.

CERAMBYCIDÆ.

Mallodon dasystomus Say, E. not rare.
melanopus Linn. E. K. not rare in June, lives in the roots of oak shrubs.

Sternodontes damicornis Linn.* Southern Florida.
Derobrachus brevicollis Hald. Polk County, one specimen.
Orthosoma brunneum Forst. E. one specimen.
Prionus pocularis Dalm. common.
  imbricornis Linn. not rare.
Elateropsis fuliginosus Fabr.* Southern Florida.
Criocephalus nubilus Lec. T. very rare.
Smodicum cucujiforme Say, E. under oak bark.
Œme rigida Say, H. rare, attracted by the light.
Chion cinctus Drury, H. C. not rare.
Eburia 4-geminata Say, E. not rare in June on sugared trees.
  stigma Ol. C. one specimen.
Elaphidion simplicicolle Hald. E. very rare.
  atomarium Dr. C. E. not rare.
  irroratum Fab.* St. Augustine.
  mucronatum Fab. E. C. not rare.
  incertum Newm. E. C. rare.
  tectum Lec. n. sp. p. 413, NS.; K. two ♂ specimens beaten from dead palmetto leaves.
  inerme Newm. not rare.
  parallelum Newm. H. S. rare.
  pumilum Newm. H. one specimen.
  subpubescens Lec. T. one specimen.
  unicolor Rand. E. very rare.
  mœstum Lec. E. very rare.
Plectromerus dentipes Oliv. T. one specimen.
Curius dentatus Newm. E. very rare.
Phyton pallidum Say, E. very rare.
Ancylocera bicolor Oliv.*
Pteroplatus floridanus Lec. H. one specimen on oak shrubs.
Callichroma melancholicum Chevr.* Southern Florida.
Stenosphenus notatus Oliv. E. one specimen.
Xylotrechus colonus Fab. E. not rare.
Neoclytus scutellaris Oliv. E. very rare.
  luscus Fab. E. rare.
Zagymnus clerinus Lec. H. E. T. very rare, lives in the stems of dry palmetto leaves.
Distenia undata Oliv. E. one specimen.
Strangalia luteicornis Fabr. E. not rare.
  strigosa Newm. rare.
Typocerus badius Newm.*
  velutinus Ol. *var.* E. rare.
  zebratus Fabr. C. S. rare.
  sinuatus Newm. H. T. rare.
Euryptera lateralis Oliv. T. E. very rare.
Monohammus titillator Oliv. E T. rare.

Dorcaschema alternatum Say, E. one specimen.
Goes tigrina DeG. E. rare.
Acanthoderes 4-gibbus Say, E. common.
  decipiens Hald. E. common.
Leptostylus aculifer Say, E. rare.
  transversatus Chevr. C. E. not rare on dead branches.
  arcuatus Lec. n. sp. p. 414, T. rare.
  biustus Lec. E. rare.
  planidorsus Lec. E. rare.
  perplexus Hald. C. two specimens.
  collaris Hald. E. not rare.
Sternidius cinereus Lec. K. one specimen.
Liopus signatus Lec. E. rare.
Lepturges symmetricus Hald. E. rare.
Graphisurus fasciatus DeG. E. rare.
Acanthocinus obsoletus Oliv. T. rare.
  nodosus Fabr. T. one specimen.
Eupogonius tomentosus Hald. T. not rare on dead pine leaves.
Zaplous Hubbardi Lec. n. g. and sp. p. 415. E. not rare on old vines.
Lypsimena fuscata Lec. H. C. very rare.
Ataxia crypta Say, C. rare.
Hippopsis lemniscata Fabr. not rare.
Spalacopsis stolata Newm. E. B. two specimens.
  suffusa Newm. A. not rare on swampy meadows in June.
Mecas femoralis Hald. C. Sumpter County, rare.
Oberea ocellata Hald. *var.* **discoidea** Lec. E. rare.
  gracilis Hald. T. one specimen.
Tetraopes canteriator Drap. E. T. rare.
Amphionycha ardens Lec. B. one specimen.
Thia pusilla Newm. C. one specimen.

BRUCHIDÆ.

Caryoborus arthriticus Fabr. not rare, lives on dead palmetto leaves; the larva in the seeds of the same tree.
Bruchus scutellaris Fab. E. rare.
  4-maculatus Fab. E. rare.
  cruentatus Horn, T. rare.
  Floridæ Horn, E. not rare, lives in the pods of a vicia.
  alboscutellatus Horn, E. rare.
  distinguendus Horn, T. rare.
  musculus Say, Orange County, rare.
  seminulum Horn, common.
  one unnamed species.

CHRYSOMELIDÆ.

Donacia lucida Lac. E. one specimen.
  piscatrix Lac. common.

Donacia rugosa Lec. n. sp. p. 415. E. rare.
Lema cornuta Fabr. C. NS. rare.
  brunnicollis Lac. F. on a species of Carduus.
  maculicollis Lac. A. not rare.
  Solani Fabr. E. not rare on a species of Solanum.
  conjuncta Lac. E. rare.
  trilineata Oliv. C. E. A. rare.
Anomoea laticlavia Forst. C. E. K. not rare on oak shrubs.
Coscinoptera dominicana Fabr. H. T. very rare.
Chlamys plicata Fabr. common.
  foveolata Kn. T. rare.
Exema gibber Oliv. common.
Monachus saponatus Fab. common.
  auritus Hald. C. H. E. rare.
  thoracicus Cr. K. T. very rare.
Cryptocephalus formosus *var.* **luteipennis** Mels. H. T. rare.
  lituratus Fabr. common.
  var. **lativittis** Germ. common.
  venustus Fabr. common.
  ornatus Fabr. common.
  guttulatus Oliv. C. very rare.
  badius Suffr. E. not rare.
  incertus Oliv. C. S. A. T. rare.
  bivius Newm. E. T. very rare on oak shrubs.
  notatus *var.* **fulvipennis** Hald. C. T. rare.
  distinctus Hald. H. C. T. rare.
  auratus Fabr. *var.?* H. C., not rare.
  atomus Suffr. common.
  pumilus Hald. not rare on willows.
  three undescribed species.
Griburius larvatus Newm. not rare.
Pachybrachys carbonarius Hald. NS. T. rare.
  trinotatus Melsh. not rare.
  atomarius Melsh. *var.?* C. H. E. not rare.
  tridens Mels. E. A. T. not rare.
  sobrinus Hald. E. rare.
  limbatus Newm. rare.
  litigiosus Suffr. B. one specimen.
  pallidipennis Suffr. T. common.
  hepaticus Mels. NS. K. T. rare.
Heteraspis marcassita Germ. *var.?* H. NS. T. not rare.
  curtipennis Melsh. common.
Myochrous denticollis Say, common.
Paria sexnotata Say, and *var.* common.
  aterrima Oliv. common.
Metachroma maculipenne Schwarz, n. sp. p. 366, C. E. not rare.

Metachroma quercatum Fabr. common.
marginale Cr. common.
floridanum Cr. C. NS. E. K. not rare.
pallidum Say, E. L. rare.
lævicolle Cr. E. A. two specimens.
pellucidum Cr. common.
Colaspis favosa Say, common.
brunnea Fabr. common.
var. **costipennis** Dej. not rare.
prætexta Say, not rare.
Chrysomela similis Rog. *var.* C. E. A. not rare.
Cephalanthi Schwarz, n. sp. p. 366, C. L. T. very rare, lives on the button bush.
multiguttis Stal. E. T. rare.
Lina scripta Fabr. E. T. common on willows.
viridis Mels. *var.*? E. T. rare.
Cerotoma caminea Fabr. K. one specimen.
Diabrotica 12-punctata Oliv. not rare.
vittata Fabr. E. rare.
vincta Lec. n. sp. p. 416, C. T. Orange County, very rare.
Galeruca americana Fabr. T. very rare.
notulata Fabr. NS. T. not rare.
notata Fabr. E. T. rare.
integra Lec. common.
Trirhabda tomentosa Linn. C. NS. T. common.
brevicollis Lec. E. common.
Hypolampsis pilosa Ill. T. very rare.
Hamletia dimidiaticornis Cr. A. one specimen in June.
Œdionychis gibbitarsis Say, E. K. common.
vians Ill. common.
var. **concinna** Fabr. rare.
thoracica Fabr. H. one specimen.
fimbriata *var.* **circumcincta** Cr. K. T. rare.
petaurista Fabr. T. very rare.
miniata Fabr. common.
6-maculata Ill. E. rare.
quercata Fabr. *var.* B. E. common.
var. **suturalis** Fabr. H. E. T. rare.
scalaris Melsh. E. not rare.
indigoptera Lec. n. sp. p. 416, T. two specimens.
Disonycha punctigera Lec. not rare.
pensylvanica Ill. common.
abbreviata Melsh. C. A. E. rare.
collaris Fabr. common.
Graptodera chalybea Ill. E. T. rare.
exapta Say, common.

Graptodera rufa Linn. common.
two unnamed species.
Longitarsus numerous unnamed species.
Batophila spuria Lec. E. rare.
cerina Lec. T. very rare.
Aphthona picta Say, H. E. T. rare.
Systena frontalis Fabr. E. L. K. not rare.
pallipes Schwarz, n. sp. p. 367, common on swampy meadows in May and June.
elongata Fabr. E. not rare.
Haltica Burgessi Cr.* Key West.
Crepidodera Helxines Linn. T. rare.
atriventris Melsh. E. T. rare.
Epitrix brevis Schwarz, n. sp. p. 367, C. E. rare.
lobata Cr. NS. rare.
hirtipennis Melsh. C. H. E. not rare.
Mantura floridana Cr.*
Crataltica insolita Melsh. C. very rare.
Chætocnemis crenulata Crotch, (*vide* p. 368), Sumter County, very rare.
pinguis Lec. n. sp. p. 417, NS. E. rare.
denticulata Ill. E. K. rare.
alutacea Cr. common on swampy meadows.
parcepunctata Cr. common.
confinis Cr. E. L. T. not rare.
pulicaria Cr. E. A. not rare.
quadricollis Schwarz, n. sp. 368, E. NS. common.
obesula Lec. n. sp. p. 418, A. B. rare.
Psylliodes lacustris Lec. H. E. K. rare.
Argopistes scyrtoides Lec. n. sp. p. 416.*
Blepharida rhois Forst. common.
Stenispa metallica Fabr. E. T. not rare.
Odontota scapularis Oliv. T. one specimen.
notata Oliv. E. C. L. rare.
bicolor Oliv. E. A. T. rare.
rubra Web. H. E. T. rare.
rosea Web. L. E. rare.
Charistena nigrita Oliv.*
Ariadne Newm. A. K. rare.
Microrhopala floridana Schwarz, n. sp. p. 369, T. NS. E. Sumter Co. rare.
Erebus Newm. common on *Solidago*.
porcata Melsh. E. T. very rare.
Porphyraspis cyanea Say, common on the leaves of *Chamærops serrulata*.
Chelymorpha cassidea Fabr. H. K. T. rare.
Coptocycla aurichalcea Fabr. not rare.
guttata Oliv. K. rare.
one undescribed? species.

TENEBRIONIDÆ.

Epitragus acutus Lec.* Southern Florida.
tomentosus Lec. common on oak and pine trees.
Schœnicus puberulus Lec. T. rare on oak trees at night time.
Branchus floridanus Lec. Middle Florida on Atlantic seashore, very rare.
Polypleurus perforatus Germ. E. Orange County, very rare.
nitidus Lec. not rare west of the St. John River, in the pine woods.
Nyctobates pensylvanica DeG. common.
barbata Knoch. common.
Haplandrus ater Lec. T. rare in decaying pine logs.
Glyptotus cribratus Lec. H. K. E. rare under old bark.
Xylopinus sáperdioides Oliv. common.
rufipes Say, L. very rare.
Tenebrio tenebrioides Beauv. common.
Sitophagus pallidus Say, T. one specimen under oak bark.
Opatrinus notus Say, common.
Blapstinus metallicus Fabr. common.
fortis Lec. n. sp. p. 420,* Southern Florida.
opacus Lec. n. sp. p. 420,* Southern Florida.
? **estriatus** Lec. n. sp. p. 420, H. C. not rare on the sea beach.
Zophobas morio Fabr.* (Occurrence very doubtful, mentioned by Dr. Horn on specimens from the Bahamas.)
Crypticus obsoletus Say, common.
Tribolium ferrugineum Fabr. rare.
Dioedus punctatus Lec. P. T. not rare.
Echocerus maxillosus Fabr. not rare.
Evoplus ferrugineus Lec. E. rare in company with *Bolitotherus bifurcus.*
Alphitobius piceus Oliv. E. rare.
Tharsus seditiosus Lec. T. not rare under old pine bark.
Uloma mentalis Horn, E. H. rare.
punctulata Lec. common under pine bark.
Anædus brunneus Ziegl. C. E. T. not rare under old leaves.
Paratenetus punctatus Sol. rare.
Pratæus fusculus Lec. T. one specimen under old leaves.
Dignamptus stenochinus Lec. n. g. and sp. p. 421, E. very rare, beaten from dead vines, one specimen.
langurinus Lec. n. sp. p. 421, E. very rare.
Phaleria punctipes Lec. n. sp. p. 421, H. rare on the ocean beach.
longula Lec. H. C. K. common on the sea beach.
picipes Say, C. common on the sea beach.
Diaperis Hydni Fabr. rare.
Hoplocephala viridipennis Fabr. common.
Platydema excavatum Say, C. E. T. rare.
cyanescens Lap. H. E. very rare.
erythrocerum Lap. common.

Platydema ruficorne Sturm. common.
flavipes Fab. common.
janus Fab. not rare.
ellipticum Fabr. common.
lævipes Hald. F. E. very rare.
micans Zimm. C. H. E. rare, lives under sticks, etc., and not on fungi as the other species.
subcostatum Lap. E. not rare.
crenatum Lec. n. sp. p. 422, H. two specimens.
Hypophlœus glaber Lec. n. sp. p. 422. T. rare.
thoracicus Mels. T. very rare on dead pine leaves.
piliger Lec. n. sp. p. 422.*
Bolitotherus bifurcus Fabr. T. common.
Rhipidandrus paradoxus Beauv. E. rare on fungi.
Pyanisia opaca Solier, Southern Florida; also in Texas and Mexico.
Helops viridimicans Horn,* T.
Strongylium anthrax Schwarz, n. sp. p. 369, E. very rare on dead oak branches.
crenatum Maeklin, E. not rare on dead branches in May and June.
simplicicolle Lec. n. sp. p. 424, E. one dead specimen.

CISTELIDÆ.

Allecula punctulata Melsh. E. rare.
nigrans Melsh. E. T. rare.
n. sp. common.
Hymenorus obscurus Say, common.
communis Lec. E. T. not rare.
dorsalis Schwarz, nov. sp. p. 370, E. T. very rare beaten from dead palmetto leaves.
densus Lec. K. NS. common on the blossoms of *Yucca* in June.
one unnamed species.
Isomira valida Schwarz. n. sp. p. 370, E. rare under old leaves.
Cteniopus Murrayi Lec. H. T. rare.

LAGRIIDÆ.

Statira croceicollis Maeklin, E. T. very rare.
gagatina Melsh. H. E. very rare.

MONOMMIDÆ.

Hyporhagus punctulatus Thoms. H. E. T. rare, beaten from dead pine leaves.

ANTHICIDÆ.

Notoxus Pilatei Laf. not rare.
n. sp. C. Sumter County, rare.

Mecynotarsus candidus Lec. NS., one specimen on the ocean beach in June.
elegans Lec. NS. C. common on the ocean beach in April and June.
Tomoderus interruptus Laf. common.
Formicomus scitulus Lec. C. S. T. common near salt water.
Anthicus vicinus Laf. common.
difficilis Lec. C. L. rare.
fulvipes Laf. common.
pallens Lec. NS. very rare on the sea beach.
ictericus Laf. not rare.
two undescribed species.
Xylophilus Melsheimeri Lec. E. one specimen.
fasciatus Melsh. E. one specimen.
piceus Lec. E. one specimen.
basalis Lec. E. very rare.
ater Lec. H. S. E. very rare.
nubifer Lec. n. sp. p. 425. E. very rare.
impressus Lec. K. T. rare, lives on dead pine leaves.
subfasciatus Lec. E. T. very rare.
quercicola Schwarz, n. sp. p. 371. E. T. not rare.
ptinoides Schwarz, n. sp. p. 371. E. NS. very rare.
ventricosus Lec. not rare.
two undescribed species.

MELANDRYIDÆ.

Scraptia sericea Mels. T. one specimen.
Allopoda lutea Hald. C. H. T. rare on oak shrubs.
Synchroa punctata Newm. H. one specimen.
Dircæa prona Lec. n. sp. p. 426. E. very rare, lives in dead oaks.
Symphora rugosa Hald. E. not rare.
Eustrophus confinis Lec. E. not rare.
bicolor Say, common.

MORDELLIDÆ.

Anaspis rufa Say, K. one specimen.
Tomoxia inclusa Lec. E. one specimen.
Glipa hieroglyphica Schwarz, n. sp. p. 372. E. rare.
Mordella melæna Germ. K. T. rare.
scutellaris Fabr. common.
irrorata Lec. not rare.
inflammata Lec. T. E. NS. not rare, especially on palmetto blossoms; larva in decaying wood.
marginata Melsh. not rare.
lineata Melsh. T. rare.
fascifera Lec. n. sp. p. 427. K. one specimen.

Mordella triloba Say, *var.?* p. 427. E. very rare.
undulata Melsh. E. very rare.
angulata Lec. n. sp. p. 427 A. one specimen.
Glipodes helva Lec. E. T. rare, attracted by the light.
Mordellistena bicinctella Lec. E. rare.
lutea Melsh. C. E. T. not rare.
trifasciata Say, E. rare.
vapida Lec. E. one specimen.
amica Lec. E. rare.
grammica Lec. E. rare.
ustulata Lec. C. one specimen.
nigricans Melsh. common.
pustulata Melsh. common.
ambusta Lec. E. A. not rare.
fuscata Melsh. E. rare.
two unnamed species.
Rhipiphorus dimidiatus Fab.*
3-maculatus Gerst. T. Polk County, rare.
pectinatus Fabr. and *var.* **ventralis** Fabr. H. T. rare.
limbatus Fabr. K. Polk and Sumter Counties, rare.
Myodites Walshii Lec. E. T. very rare.

MELOIDÆ.

Macrobasis unicolor Kby. not rare.
Epicauta strigosa Schh. common.
Batesii Horn, common on swampy meadows in May and June.
lemniscata Fabr. E. common in May.
sanguinicollis Lec. Sumter County, not rare on *Schrankia uncinata.*
Zonitis longicornis Horn, T. very rare.
Nemognatha piezata Fabr. E. K. not rare.
nemorensis Hentz, T. very rare.

ŒDEMERIDÆ.

Xanthochroa lateralis *var.* **signaticollis** Hald. E. very rare.
Oxacis thoracica Fabr. common on palmetto blossoms.
notoxoides Fabr. not rare.
dorsalis Melsh. NS. C. not rare on the sea beach.
several unnamed species.
Probosca pleuralis Lec. B. K. rare.

RHYNCHITIDÆ.

Auletes Cassandræ Lec. C. one specimen.
Eugnamptus striatus Lec. C. H. T. rare on oak shrubs in March and April.
Rhynchites hirtus Oliv. H. E. T. not rare.
æratus Say, rare.
Pterocolus ovatus Gyllh. H. T. rare.

ATTELABIDÆ.

Attelabus analis Ill. common.

OTIORHYNCHIDÆ.

Epicærus formidolosus Boh. T. rare.
Agraphus bellicus Say, T. K. rare.
Neoptochus adspersus Boh. common on oak shrubs.
Pachnæus opalus Oliv.* Northern and Middle Florida, not rare.
　　distans Horn, E. K. T. not rare on pine and oak trees.
Tanymecus lacæna Hbst. rare.
Pandeletejus hilaris Hbst. E. common.
Artipus floridanus Horn, C. H. NS. not rare.
Lachnopus floridanus Horn,* Southern Florida.
Eudiagogus pulcher Fahræus.

CURCULIONIDÆ.

Listronotus nebulosus Lec. T. E. common.
　　setosus Lec. T. E. not rare.
Macrops numerous unnamed species.
Pachylobius picivorus Germ. T. on pines, common.
Hylobius pales Boh. P. rare.
Hilipus squamosus Lec.*
Lixus sylvius Boh.? T. two specimens.
　　fossus Lec. E. not rare.
　　two undescribed species.
Smicronyx sp. B. E. very rare.
Phyllotrox ferrugineus Lec.*
Endalus ovalis Lec. common.
Brachybamus electus Germ. common.
Onychylis nigrirostris Boh. common.
Stenopelmus rufinasus Gyll. E. one specimen.
Bagous mammillatus Say, B. E. K. rare.
　　americanus Lec.*
　　obliquus Lec. E. not rare.
　　cavifrons Lec. E. T. rare.
　　pusillus Lec. C. one specimen.
　　bituberosus Lec. C. E. T. very rare.
　　two undescribed species.
Otidocephalus dichrous Lec. C. L. E. rare on dead palmetto leaves.
　　myrmex Hbst. H. C. T. rare on oak shrubs.
Anthonomus signatus Say, S. rare.
　　musculus Say, K. T. rare.
　　sulcifrons Lec. B. one specimen.
　　flavicornis Boh. T. E. common.
　　pusillus Lec. NS. rare.
　　elegans Lec. H. very rare on oak shrubs.

Anthonomus Cratægi Walsh, common.
  subfasciatus Lec. common.
Piazorhinus pictus Lec. E. one specimen.
Plocetes Ulmi Lec. E. one specimen.
Miarus hispidulus Lec. B. very rare.
Notolomus bicolor Lec. common on palmetto blossoms.
  basalis Lec. common with the preceding, but also on other plants.
  Myricæ Lec. E. NS. very rare on a species of myrtle in June.
Læmosaccus plagiatus Fabr. T. rare.
Conotrachelus retentus Say, H. one specimen.
  seniculus Lec. E. rare.
  affinis Boh. E. rare.
  elegans Boh. C. very rare.
  ventralis Lec. n. sp. p. 428, E. one specimen.
  posticatus Boh. S. E. not rare.
  cognatus Lec. n. sp. p. 429, NS. very rare.
  pusillus Lec. n. sp. p. 429, E. one specimen.
  geminatus Lec. T. one specimen.
  infector Boh. C. T. very rare.
  coronatus Lec. n. sp. p. 430, E. two specimens.
  anaglypticus Fahrs. H. one specimen.
Micralcinus cribratus Lec. C. very rare.
Rhyssematus palmacollis Say, E. rare.
Chalcodermus spinifer Boh. Sumter County, one specimen.
  æneus Boh. NS. E. T. not rare.
  inæquicollis Horn, *var.?* C. one specimen.
  collaris Horn, E. K. T. not rare.
Acamptus rigidus Lec. E. very rare.
Acalles granosus Lec. H. S. E. very rare.
  subhispidus Lec. p. 431. n. sp. Sumter County, one specimen.
  clavatus Say, common.
  crassulus Lec. common.
  longulus Lec. H. one specimen.
  nuchalis Lec. C. S. E. rare.
  ventrosus Lec. n. sp. p. 430. E. T. two specimens.
Pseudomus sedentarius Say, E. very rare on dead vines.
Tyloderma foveolatum Say, not rare.
  longum Lec. H. E. two specimens.
  æreum Say, common.
Cryptorhynchus bisignatus Say, H. E. rare.
  pumilus Boh. H. E. rare.
  obtentus Hbst. E. rare.
  helvus Lec. n. sp. p. 431. E. very rare on dead vines.
  fallax Lec. E. not rare.
  minutissimus Lec. E. not rare.

Cryptorhynchus apiculatus Gyll. H. E. very rare.
oblongus Lec. E. rare.
ferratus Say. C. H. E. common.
Piazurus oculatus Say, E. rare.
Copturus nanulus Lec. E. one specimen.
Craponius inæqualis Say, E. T. very rare.
Cœliodes asper Lec. A. one specimen.
nebulosus Lec. C. E. T. not rare.
Pelenomus squamosus Lec. T. very rare.
Cœlogaster obscurus Lec. not rare.
Rhinoncus longulus Lec.*
Aulobaris Ibis Lec. E. B. rare.
Baris strenua Lec. K. T. very rare.
nitida Lec. C. H. E. K. not rare.
interstitialis Say, H. T. not rare on a white flowering thistle.
ærea Boh. common.
Pseudobaris pectoralis Lec. NS. one specimen.
nigrina Say, NS. not rare.
anthracina Lec. A. K, not rare on swampy meadows.
albilatus Lec. E. A. T. common on swampy meadows.
T-signum Boh. common with the preceding.
Madarus undulatus Boh. E. very rare.
Pachybaris porosa Lec. NS. E. not rare, exclusively on palmetto blossoms.
Stethobaris corpulenta Lec. A. T. rare.
Microcholus striatus Lec. L. H. one specimen.
puncticollis Lec. A. E. B. not rare on swampy meadows.
lævicollis Lec.*
Centrinus scutellum-album Say, not rare.
penicellus Hbst.*
picumnus Hbst. NS. E. T. not rare on palmetto blossoms.
decipiens Lec. K. two specimens.
calvus Lec. E. one specimen.
canus Lec. E. one specimen.
concinnus Lec. common on swampy meadows.
confusus Boh. not rare with the preceding.
Zygobaris nitens Lec.* Key West.
conspersa Lec. E. (Found also in Illinois.)
?convexa Lec. T. E. two specimens.
Barilepton bivittatum Lec. n. sp. p. 431,* Northern Florida.
lineare Lec. A. Sumter County, very rare.
cribricolle Lec. E. one specimen.
Hormops abducens Lec. C. one specimen.

BRENTHIDÆ.

Eupsalis minuta Drury, E. very rare.

CALANDRIDÆ.

- **Rhynchophorus cruentatus** Fabr. common, lives on *Chamærops palmetto.*
- **Sphenophorus inæqualis** Say, T. very rare.
  - **cariosus** Oliv. C. A. E. rare.
  - **sculptilis** Uhler, E. T. rare.
  - **placidus** Say, not rare.
  - **apicalis** Lec. n. sp. p. 432, T. one spec. on the sea beach.
  - **parvulus** Gyll. F. T. rare on the the sea beach.
  - **retusus** Gyll. S. one specimen.
  - **Germari** Horn, T. rare.
  - **velutinus** Lec.*
- **Rhodobænus 13-punctatus** Ill. E. not rare.
  - *var.* **5-punctatus** Say, F. not rare on a species of thistle.
- **Calandra Oryzæ** Fabr. common in corn.
- **Dryophthorus corticalis.*** Northern Florida.
- **Dryotribus mimeticus** Horn, NS. rare under boards on the lagoon beach.
- **Gononotus lutosus** Lec. H. one specimen.
- **Homaloxenus dentipes** Woll.* Middle Florida.
- **Cossonus corticola** Say, common under pine bark.
  - **impressifrons** Boh.*
- **Macrancylus linearis** Lec. C. not rare under boards on the ocean beach.
- **Caulophilus latinasus** Say, E. rare beaten from dead twigs.
- **Mesites rufipennis** Lec. n. sp. p. 432, NS. one specimen on the beach.
- **Wollastonia quercicola** Boh. NS. E. very rare.
- **Amaurorhinus nitens** Horn, E. not rare on dead twigs.
- **Stenoscelis brevis** Boh.*

SCOLYTIDÆ.

- **Platypus flavicornis** F. P. E. under pine bark, also attracted by the light.
  - **quadridentatus** Oliv. E. one specimen.
  - **compositus** Say, E. not rare.
- **Monarthrum fasciatum** Say, E. one specimen.
  - **mali** Fitch, S. E. rare.
- **Pityophthorus materiarius** Fitch. T. rare.
  - **pulicarius** Zimm. K. T. not rare on pine trees.
  - **obliquus** Lec. n. sp. p. 432, E. one specimen.
  - **seriatus** Lec. n. sp. p. 433, T. one specimen on pine trees.
- **Hypothenemus hispidulus** Lec. H. E. rare.
  - **dissimilis** Zimm. E. T. rare.
- **Xyleborus fuscatus** Eichh. E. T. common.
  - **biographus** Lec. E. K. not rare.
  - **xylographus** Zimm. E. one specimen.
  - **pubescens** Zimm. common.
  - **cælatus** Zimm. K. T. common under pine bark.
- **Cryphalus miles** Lec. n. sp. p. 433, T. rare on dead pine leaves.

Tomicus calligraphus Germ. P. T. common.
cacographus Lec. T. common.
avulsus Eichh. E. K. T. not rare.
Micracis nanula Lec. H. very rare.
Cnesinus strigicollis Lec. E. one specimen.
Dendroctonus terebrans Oliv. T. rare.
Hylastes porculus Er. E. rare.
tenuis Zimm. C. one specimen.
exilis Chap. E. B. T. rare.

ANTHRIBIDÆ.

Ischnocerus infuscatus Fahrs. E. rare on dead branches.
Tropideres rectus Lec. S. E. rare with the preceding.
Toxotropis pusillus Lec. T. one specimen.
Phœnicobius Chamærops Lec. C. H. E. common on fresh cut palmetto leaves.
Piezocorynus mixtus Lec. E. T. rare.
mœstus Lec. E. rare on dead branches.
Anthribus cornutus Say, H. E. not rare.
lividus Lec. L. one specimen.
Toxonotus fasciculatus Schh. E. one specimen.
Cratoparis lunatus Fabr. H. E. common.
lugubris Oliv. E. rare.
Brachytarsus limbatus Say, A. K. rare on swampy meadows.
tomentosus Say, C. K. rare.
variegatus Say, C. H. E. not rare.
Anthribulus rotundatus Lec. common on swampy meadows.
Aræocerus fasciculatus DeG. F. T. not rare, raised from the pods of a large yellow flowering shrub belonging to the Mimosaceæ.
Euxenus piceus Lec. n. sp. p. 433. T. one specimen.

APIONIDÆ.

Apion metallicum Gerst.*
nodirostre Gerst.*
segnipes Say, T. common.
several unnamed species.

ERRATA.

P. 438 in **Hydroporus** for **fuscatus** read n. sp.
P. 438 for **Suphis** n. sp. read **Laccophilus** n. sp.
P. 447 in **Carpophilus** for **ferrugineus** read **tempestivus** Er.
P. 456, line 1, for **Sternodontes** read **Stenodontes**.

Remarks on Geographical Distribution.

By John L. LeConte, M.D.

In now concluding this, the most complete faunal list of insects which has been prepared in the United States, it may be proper to make a few remarks on the subject of geographical distribution as exhibited by the Coleoptera above enumerated. Any observations now offered, must be very imperfect, and subject to large corrections when the faunal lists of the Coleoptera of other parts of the country have been prepared with equal care and industry.

The total number of species contained in the list (exclusive of Aleocharini, not yet studied) is 1457.

Of these the following are also found in the Antilles : ....(18?), 17.

Cicindela tortuosa (Mex., S. Am., Cala.).
Dermestes cadaverinus (S. Am., Siberia).
Nemicelus marginipennis.
Carpophilus tempestivus.
Epuræa luteola.
Bothrideres geminatus.
Actenodes auronotata.
Megapenthes Sturmii.
Dicrepidius ramicornis (S. Am.).
Tetrapriocera Schwarzi.
Stenodontes damicornis.
Elateropsis fuliginosa.
Elaphidion irroratum.
Curius dentatus.
Leptostylus transversatus.
Thia pusilla.
Homaloxenus dentipes.
Zophobas morio (doubtful).

Common to Florida and Mexico and partly found in Texas are : ..... 8.

Cicindela hamata.
Epierus brunnipennis.
Saprinus dentipes.
Actenodes calcarata.
Callichroma melancholicum.
Pyanisia opaca.

Common to Texas, Arizona and Southern California : .... 4.

Scarites californicus (C).
Platynus floridanus [compare texanus (T.) and californicus (C.)]
Spalacopsis stolata (T.)
Epitragus acutus.

I have excluded from this category those which are known to occur north of Florida, and are thus found continuously around the Gulf, in Alabama, Louisiana and Texas.

Common to Florida and South America : .... 7.

Cybister Olivieri.
Tanygnathus collaris.
Nematidium mustela.
Saprinus braziliensis.
Atænius sculptilis.
Hemirhipus fascicularis.
Chalcodermus spinifer.

Besides these, the anomalies in distribution worthy of being noticed in neighboring regions are :

Sosylus dentiger *Horn*, Lower California and San Domingo.

Dacoderus, one species in Arizona ; another in San Domingo.

And also these relations with more distant regions:

Argopistes; Florida and North Eastern Asia.
Onota; Florida and South America.
Brachypeplus (section); Florida and Africa.
Mesites; Florida, Delaware and Europe.
Stenoscelis; Southern States and Cape of Good Hope.

A remarkable feature in the geographical distribution, as exhibited by this list of Coleoptera is the comparatively small number of species common to Florida and the Antilles. A little reflection on the geological development of Florida, and its relation to the Gulf Stream will show the reason for this apparent anomaly.

The Peninsula of Florida has extended southward during comparatively modern times by the gradual growth of coral reefs and their subsequent conversion into land surface; this surface would naturally be occupied by the insects and plants living in the conterminous northern regions, as far as they were able to endure the approach to a tropical climate. On the other hand the Gulf Stream, more and more compressed by the narrowing of the strait between Florida and Cuba, would have a tendency to interrupt all transfer of living beings from the Island to the Continent; while the passage of species from the coast of Mexico and Northern South America to either Florida or the Antilles would be slightly facilitated.

The occurrence of *Sosylus* and *Dacoderus*, in the deserts near the Pacific coast and in San Domingo must be referred to a much older condition of things, when the connections of land surface were quite different from that of the present time; and in fact the characters of the genera indicate that they are old forms. *Sosylus* is a Colydiide related somewhat to the Australian and North American *Derataphrus;* while *Dacoderus* differs from every other Tenebrionide by the front coxæ being contiguous.

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On the Calculation of Results in Gas-Analyses.

By Samuel P. Sadtler, Ph.D.

(*Read before the American Philosophical Society, April 5th,* 1878.)

At the last meeting of the Society I promised to present a full discussion of the formulas involved in calculating analyses of gaseous mixtures such as are found exhaling from the earth in the oil-regions of Western Pennsylvania and elsewhere. I am led to do this at present, chiefly because of some remarks made upon this subject by Prof. Henry Morton, in an article in the "American Gas-Light Journal" of Feb. 16th, 1878. Otherwise I should have deferred a discussion of the subject until I should have completed some absorption-tests upon the gases and analyses of portions of the gaseous mixtures withdrawn by such absorptions. This complete discussion of the subject I promised in a verbal communication made to the Society at its meeting on Sept. 21st last, mention of which is made on page 11 of No. 100 of the Proceedings.

In the article of Prof. Morton alluded to, he shows that the eudiometric combustion of a mixture of hydrocarbons of the Paraffin series cannot give results capable of being reckoned into percentage composition, and referring to my article published in the Proceedings, Vol. XVI, pp. 206 and 585, shows that an error in my formulas enabled me to get a "solution in appearance where no solution was possible."

This error in the formulas I had discovered myself in the Spring of 1877, and I had the absorption tests which I had described at the meeting of Sept. 21st last made purposely to enable me to solve the question of the composition of the gases independently of the use of formulas. In a private letter to Prof. Morton, dated Dec. 31st last, in answer to one received from him a day or two before, calling my attention to the error, I acknowledged the error of the formula used by me in my printed paper, and mentioned that I was proposing to rectify the results as first published by the aid of other tests.

With reference to the matter of the impossibility of determining the composition of a mixture of gases belonging to the Paraffin or marsh-gas series, Prof. Morton shows very clearly in his paper that this impossibility does exist when we take three or more paraffins or a mixture of hydrogen and two or more paraffins. In this latter case the hydrogen molecule simply acts like a member of the series lower than marsh-gas or CH_4.

When we ask the question with reference to two members of this series, however, we find that a solution is not impossible. In reckoning the results of analyses of ordinary illuminating gas, it is always necessary to calculate the relative amounts of hydrogen and marsh-gas from the results of the eudiometric combustion, and what is true of marsh-gas and hydrogen (which latter we have just said must in such cases be considered as a lower member of the marsh-gas series) is true of marsh-gas and ethyl-hydride or marsh-gas and propyl-hydride. So we may, in dealing with the mixture of gases which has been submitted to a eudiometric combustion, and which we know by previous tests and absorptions cannot contain anything else than hydrogen and the members of the Paraffin series, assume as the basis of our reckoning hydrogen and any member of the Paraffin series or marsh-gas and any single higher member of the same series. Several of these possible assumptions are alluded to in my paper read February 18th, 1876, found in No. 97 Proceedings, p. 210, and reasons given why they were then rejected as not applicable.

The reason why I was led into adopting the formulas used at that time are also given in the same connection. I made an error in the equation chosen to represent the contraction ensuing from the endiometric combustion, taking $8x + 2y + \frac{5}{2}z = A$, instead of $\frac{3}{2}x + 2y + \frac{5}{2}z = A$., where x = hydrogen, y = marsh-gas, z = ethyl-hydride and A = the observed contraction in volume of the gaseous mixture after the passage of the spark. I had used in reckoning the contraction of hydrogen the atom H instead of the free molecule H_2. As stated (loc. cit.) I found in Fougué's memoirs a confirmation of my results. The same error had evidently existed in his mind, although it did not show as plainly, as he published no percentage results. After giving equations to be used on the supposition of a mixture of marsh-gas, ethyl-hydride, and propyl-hydride, he says: "Tout mélange de carbures d'hydrogène de la formule $c^{2n}\ H^{2n} + {}^{2}$ doit remplir la condition exprimée par cette dernière equation, c'est à-dire que le volume de l'acide carbonique formé dans l'eudiomètre par combustion doit être éqal á deux fois l'absorption produite moins trois fois le volume du gaz. Le mélange de ces carbures avec l'hydrogène libre ou avec d'autres carbures d'hydrogène empêche cette condition d'être realisée. Il est done facile des reconnaître si un mélange de carbures d'hydrogène gazeux contient exclusivement des carbures de formule $c^{2n}\ H^{2n} \div {}^{2}$."—*Compt. Rend.* Vol. 87, p. 1048.

Finding in the combustion results of all the analyses reported upon in my first paper an excess of contraction over that required by Fougué's law just stated above, I ascribed it (as he did in theory) to the presence of hydrogen. I felt sure that I had sufficient knowledge of the details of the manipulation and of the errors to be avoided there, to put out of the question the idea that this excess of contraction might be owing to having passed the spark with an insufficient supply of diluting air present with the explosive mixture in the eudiometer. The contraction was proportionally great too in parallel analyses of the same gas.

I recognized, as before stated, shortly after the publication of the second paper, the error in the formula expressing the contraction, and saw that while the qualitative tests described in my first paper showed the presence of ethyl and propyl-hydrides, the quantitative results based upon a wrong formula would have to be revised.

Before publishing my final revision of them, I desired to verify in the fullest way my qualitative absorption results before published, and to obtain, by the aid of these absorptions, material better adapted to give satisfactory quantitative results. This work, though unavoidably interrupted and delayed, I have now in hand. Without giving at present any final revision to my published analyses, I feel obliged to notice a criticism made upon them in Prof. Morton's article above referred to. After stating that no solution of the problem of analysing a mixture of three members of the Paraffin series, or of hydrogen and two members of the same series was possible, Prof. Morton concludes by saying, with reference to my analyses, "and his determinations have therefore no value whatever."

In reply to this, I would say that, while, in view of the demonstration made by Prof. Morton in his paper, which was by the way fully accepted by me before I saw it in his article, I am unable to accomplish all that I first thought I could, my figures are still of *some* account. They possess just the same value and can be used in just the same way as the figures obtained by any analyist in making an analysis of ordinary illuminating gas.

As shown in the first part of this paper, we are able to determine from the combustion results, the proportions in a mixture considered as made up of two members of the Paraffin series or of hydrogen and one member of the series. That this can be done with a gas known to contain the higher Paraffins along with marsh-gas, is shown in Prof. Morton's own analysis of a water-gas in which he had proved these Paraffins to be present (loc. cit.). It is shown in the analysis of Prof. Morley of the natural gas from the Neff. Well. Ohio, quoted in my second paper (loc. cit.).

My results then can be reckoned in this way, and the gaseous mixture which is submitted to the eudiometric combustion can be figured as made up of hydrogen and marsh-gas, or of marsh-gas and ethyl-hydride, as is more reasonable in all these cases. Here, however, hydrogen is not necessarily excluded, for part of what is reckoned as marsh-gas may be a mixture of equal parts of hydrogen and ethyl-hydride, and what is reckoned as this latter may be only that amount which is in excess of the hydrogen present.

Thus, in my first paper, I gave as present in the gas of the Burns Well 6.10% hydrogen, 75.44% marsh-gas, and 18.12% ethyl-hydride. If I calculate the combustion results (using the carbonic acid formed) given on p. 211 Proceedings No. 97, for marsh-gas and ethyl-hydride, I get as the average of the two analyses 87.66% marsh-gas and 12.00% ethyl-hydride. Now if this latter number 12.00% be taken from the 18.12% reckoned before, we have 6.12%, which combining with the 6.10% of supposed hydrogen would increase the 75.44% of marsh-gas to 87.66% of marsh-gas.

In the Erie gas, where only a trace of hydrogen was assumed before to be present, I can reckon the combustion results, using both the carbonic acid formed and the contraction ensuing on the combustion, and get results which do not differ greatly from those already published. Thus I gave before .43% hydrogen, 40.33% marsh-gas, and 58.26 ethyl-hydride. Calculated for the two latter constituents only, I get 40.53% marsh-gas and 58.49% ethyl-hydride.

I do not propose, however, to give these or any results as final until I have finished the examination of the gases which I had absorbed with different reagents and of various decomposition products obtained from them. I hope then to be able to establish with some certainty the exact character of the natural gases which I have made the subject of study.

UNIVERSITY OF PENNA., *April 5th*, 1878.

CONTRIBUTIONS FROM THE LABORATORY OF THE UNIVERSITY OF PENNSYLVANIA.

No. XIII.

A Study of some of the Derivatives of Mono- and Dichlor-Salicylic Acids.

By Dr. John Marshall.

(Read before the American Philosophical Society, April 5th, 1878.)

This work was undertaken at the suggestion of Dr. Edgar F. Smith, to whom, for his many kindnesses shown during the progress of the investigation, I would express my best thanks.

Of late years the monohydroxyl substitution products of benzoic acid—salicylic acid and its isomers—have been completely investigated, and many interesting facts regarding the nature of these acids revealed. Of the uninvestigated derivatives of salicylic, metaoxybenzoic and paraoxybenzoic acids remain yet the mono and dichlorinated compounds. In the following pages will be described my results obtained from the study of simply the mono and dichlor acids derived from salicylic acid.

These new compounds that I have obtained show in several instances the stability imparted to compounds into which one or more chlorine atoms have been introduced.

Monochlorsalicylic Acid.

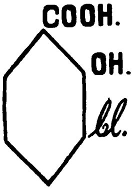
$C_6 H_3 Cl O H C O O H.$

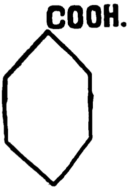
Fusing point 172°.

This acid was first obtained by Hübner and Brenken (Berichte der deutschen Chem. Gesellschaft, 1873, p. 174). Their manner of producing it consisted in mixing ordinary salicylic acid with an excess of carbon bisulphide and conducting chlorine into the mixture, which was continually shaken. When the calculated amount of chlorine had been introduced, the contents of the flask were emptied into a large basin and evaporated to dryness on a water bath. The dry residue was taken up in water and crystallized from this in needles which fused at 172° C. The lead, silver, copper and barium salts were simply described, further investigation being neglected.

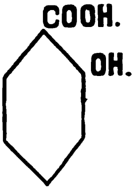
Hübner and Weiss produced metachlorbenzoic acid, and by nitration, amiding and forming the Diazo-compound, and subsequently treating the latter with water they obtained metachlororthoxybenzoic acid, fusing at

171° C. and perfectly identical with the monochlorsalicylic acid. The graphic formula of the latter would be represented by the following:

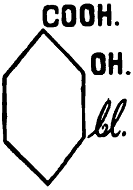




Benzoic Acid.



Orthoxybenzoic Acid
(Salicylic Acid.)



Metachlororthoxybenzoic Acid.

Cahours in 1845 described a similar acid, "*Acide monochlorosalicylique*" (Ann. Chim. Phys. 13, 106), but never obtained it in a pure condition.

The method I pursued to secure the acid for my investigations was the following: A weighed amount of the purest salicylic acid that could be obtained (melting at 155° C.) was brought into a capacious flask, and a rather large quantity of concentrated acetic acid added. Into this mixture a calculated amount of dry chlorine gas was conducted. The heat generated by the reaction soon caused the solution of the salicylic acid. The liquid gradually acquired a yellowish-brown color. When the calculated amount of chlorine had been introduced, water was added in large excess and the solution allowed to stand several hours before filtering off the acid that had separated out in large white flocculent masses. After thoroughly washing the acid with cold water, it was boiled with a large quantity of barium carbonate and water. The liquid was filtered from the excess of the latter salt, evaporated and allowed to stand over night. Upon examination crystals of barium dichlorsalicylate were usually discovered. The mother liquid poured off from these and further concentrated yielded the barium salt of the monochlor acid. This salt I invariably recrystallized several times, and then added dilute hydrochloric acid to its aqueous solution which precipitated the acid in perfectly white flocculent masses.

The acid was recrystallized several times from water separating out from this menstruum in long colorless needles which fused at 172° C. In warm water the acid is readily soluble.

Inasmuch as this acid differs from salicylic in having one atom of chlorine, its antiseptic properties might be enhanced, and owing to its ready solubility would therefore render it preferable to salicylic acid.

An aqueous solution of the acid mixed with ferric chloride gives a beautiful violet coloration.

An analysis of the material thus prepared gave the final proof that the compound formed was the desired monochlorsalicylic acid.

.1417 grms. dried acid burned with coarse and fine lead chromate gave 48.13 % carbon, and 3.00 % hydrogen.

Calculated per cent.	Found per cent.
$C_7 = 84 = 48.69\%$	48.13 %
$H_4 = 4 = 2.89\%$	3.00 %
$Cl = 35.5 = 20.58\%$	——
$O_3 = 48. = 27.84\%$	——
171.5 100.00	

SALTS.

For a more complete recognition of the acid the following salts were made and analyzed :

BARIUM MONOCHLORSALICYLATE.

$$(C_6\,H_3\,Cl\,OH\,COO)_2\,Ba + 3\,H_2\,O.$$

Obtained by boiling the aqueous solution of the acid with an excess of barium carbonate and filtering. The filtrate upon concentration and standing for some time, yielded white, bright, shining crystals of this salt. In cold water it is soluble, and when the liquid is warmed the compound dissolves very readily.

Water Estimation.

0.2000 Grms. air-dried salt lost upon heating for four hours at 170° C., .0200 Grms. $H_2O = 10.00\%$ H_2O.

The calculated per centage of water for 3 molecules $H_2O = 10.11\%$.

Calculated.	Found.
$(C_6\,H_3\,Cl\,OH\,COO)_2\,Ba = 480 = 89.89\%$	——
$+ 3\,H_2O = 54 = 10.11\%$	10.00 %
534 100.00	

Barium Estimation.

0.121 Grm. anhydrous salt was placed in a platinum crucible, a few drops of sulphuric acid was then added and this evaporated to dryness. .0594 Grm. barium sulphate were obtained, corresponding to .0349 Grm. barium = 28.83 % Ba.

Calculated per cent.	Found per cent.
$(C_6\,H_3\,Cl\,OH\,COO)_2 = 343 = 71.45\%$	——
$+ Ba = 137 = 28.55\%$	28.83 %
480 100.00	

Potassium Monochlorsalicylate.

$C_6 H_3 Cl OH COOK.$

Formed by boiling a solution of the Barium salt with a calculated amount of potassium sulphate and evaporating the filtrate; or by boiling the free acid with a slight excess of potassium carbonate.

The salt crystallizes from its aqueous solution in long colorless needles, very soluble in cold and hot water. Analysis showed it to be anhydrous.

Potassium Estimation.

.1168 Grm. dried salt evaporated in a platinum crucible with sulphuric acid, gave .0491 Grm. potassium sulphate, which corresponds to .0220 Grm. potassium = 18.83% K.

Calculated per cent.			Found per cent.
$C_6 H_3 Cl OH COO$ =	171.5 =	81.48%	——
+ K =	39.1 =	18.52%	18.83%
	210.6	100.00	

Sodium Monochlorsalicylate.

$C_6 H_3 Cl OH COO Na.$

I prepared this salt in a manner similar to the preceding potassium compound. From concentrated aqueous solution it crystallizes in short, straw-colored needles, easily soluble in cold or warm water. It is anhydrous.

Sodium Estimation.

0.2986 Grm. dried salt treated just as in the preceding analysis, gave .1081 Grm. sodium sulphate, which corresponds to .0350 Grm. sodium = 11.72% Na.

Calculated per cent.			Found per cent.
$C_6 H_3 Cl OH COO$ =	171.5 =	88.18%	——
+ Na =	23. =	11.82%	11.72%
	194.5	100.00	

Lithium Monochlorsalicylate.

$C_6 H_3 Cl OH COO Li + 2 H_2O.$

I made this salt by boiling the free acid with a slight excess of Lithium carbonate. The filtered solution was then strongly evaporated and placed over sulphuric acid to crystallize. After long standing the salt appeared in large, broad, colorless plates—very hard—which were united to aggregated masses. After several recrystallizations the salt was analyzed.

Water Estimation.

.1876 Grm. air-dried salt heated for three hours at 130° C. lost .0030 Grm. H_2O = 1.59% H_2O.

2 molecules H_2O require 1.67%.

Lithium Estimation.

.1846 Grm. of the perfectly dried salt were treated with a few drops of concentrated sulphuric acid and evaporated to dryness in a platinum crucible. .0566 Grm. lithium sulphate were obtained = .0072 Li = 3.90% Li.

Calculated per cent.			Found per cent.
$C_6 H_3 Cl OH COO$ =	171.5 =	96.08%	——
+ Li =	7. =	3.92%	3.90%
	178.5	100.00	

ETHERS.

The introduction of various hydro-carbon residues yielded me in most instances well crystallized and stable derivatives. The method pursued in all cases for the production of these compounds was to treat the silver salt of the acid with a monohalogen derivative of the hydro-carbon to be introduced: e. g.

$$C_6 H_3 Cl OH COO Ag + C_x H_y I = Ag I + C_6 H_3 Cl OH COO C_x H_y.$$

Methyl Iodide.—$C H_3 I$. This I prepared as follows: 50 Grms. iodine were mixed in a flask with 20 Grms. methyl alcohol and 5 Grms. amorphous phosphorus gradually added. As heat is generated in this reaction, the flask was kept in a basin of cold water. The mixture was first subjected to distillation after having stood twelve hours. The first distillate was in all cases treated with sodium hydrate and calcium chloride, and then redistilled.

Ethyl Iodide.—$C_2 H_5 I$. Made this compound according to the directions given for its production: 1 part amorphous phosphorus, 5 parts ethyl alcohol, and 10 parts iodine were treated as above. Boils at 72°C.

Isobutyl Iodide.—$CH_2 I CH (CH_3)_2$. 50 Grms. iodine, 50 Grms. isobutyl alcohol, and 8 Grms. amorphous phosphorus were distilled together. A heavy, oily liquid boiling at 119°C.

Acetyl Chloride.—$CH_3 CO CL$. Prepared this by distilling equal parts of anhydrous acetic acid and phosphorus pentachloride.

Description of Ethers.

METHYL MONOCHLORSALICYLATE.

$$C_6 H_3 Cl OH COO CH_3.$$

Fusing point, 48°C.

Silver monochlorsalicylate was heated together with an excess of methyl iodide in a sealed tube at 140°C for twelve hours, and upon opening the tube and expelling the excess of methyl iodide, a residual oil was left. Even when kept in a cold place solidification was not effected. As I thought that this very probably was nothing more than a decomposition product—the result of too intense heating—I treated a second portion of the silver salt in a similar manner, taking care, however, not to let the temperature become too great. The thermometer indicated 103°C for three hours. The color of the liquid in the tube was dark red. The tube was opened and the liquid filtered off from the silver iodide which was washed with alcohol, and the solution then evaporated almost to dryness. Upon allowing the solution to stand over night, I observed the next morning that the liquid had solidified perfectly. The mass was removed from the beaker glass, reduced to a fine powder, and after being exposed to the air for several days, it was dissolved in alcohol.

Upon warming the solution the mass dissolved readily, and upon cooling the compound separated out in long, colorless needles. These fused at 48°C, upon recrystallization I discovered that the fusing point remained constant, and the substance was then subjected to an analysis.

Carbon and Hydrogen Estimation.

.2235 Grm. well dried substance burned with lead chromate, gave .4228 Grm. CO_2 = .1150 Grm. carbon, corresponding to 51.45% carbon. And further, .0851 Grm. H_2O = .0095 Grm. hydrogen, equaling 4.25% hydrogen.

Calculated per cent.			Found per cent.
C_8	= 96	= 51.47%	51.45%
H_7	= 7	= 3.75%	4.25%
O_3	= 48	= 25.74%	——
Cl	= 35.5	= 19.04%	——
	186.5	100.00	

Cahours (Ann. Chim. Phys. 10. 343) mentions a methyl ether of chlorsalicylic acid produced by the action of chlorine upon methyl salicylic acid. It was difficult to obtain it pure. I believe this to be entirely different from my compound above described.

ETHYL MONOCHLORSALICYLATE.

$C_6 H_3 Cl OH C O O C_2 H_5$.

I have succeeded in forming this compound, but as I have never had it in pure enough condition to make an analysis, I give merely my experience in its formation. Time and again I heated the pure silver salt with perfectly pure ethyl iodide, but when I searched for the resulting ether, I obtained nothing more than a dark heavy liquid that remained in this condition under all circumstances. That this was nothing else than a decomposition product I learned afterwards. High heat is not required for the formation of this compound, it is produced just as soon as the silver salt and ethyl iodide are shaken well with each other, the reaction is indicated by the increase of temperature that may be noticed by placing the hand on the vessel containing the mixture. A portion of the silver salt with ethyl iodide was heated in a sealed tube in a water bath for three hours, the tube was then opened, contents thrown upon a filter and the silver iodide washed with alcohol, and the filtrate evaporated on a water bath almost to dryness. The compound crystallized in stellated masses fusing at 110° C.

ISOBUTYL MONOCHLORSALICYLATE.

My attempts to obtain this ether were futile. With the greatest care I never succeeded in obtaining the compound, that I may have destroyed it by too intense heating, if it was formed, I do not consider possible, as I not only heated a mixture above 100° C., but also in luke-warm water, the latter temperature is necessary to effect the formation of silver iodide. I think that very likely simple exposure to the air in process of drying caused the decomposition of the ether into the acid.

ACETYL MONOCHLORSALICYLATE.

$$C_6\,H_3\,Cl\,O\,H\,COO,\,O\,C\,C\,H_3.$$

Fusing point 149° C.

I obtained this compound by heating the silver salt a number of hours with acetyl chloride at a temperature not over 130° C. The contents of the tube were placed on a filter, the silver chloride washed with alcohol and the filtrate evaporated upon a water bath and then allowed to crystallize, the ether separated in dark acicular masses, these were pressed well between paper and fused at 147° C. The compound was recrystallized four times from alcohol, in which it is readily soluble. The pure ether fuses at 149° C. A combustion gave the above composition. Water decomposes the ether.

Carbon and Hydrogen Estimation.

.0763 Grm. dried substance gave 50.00% carbon and 3.93% hydrogen.

Calculated per cent.	Found per cent.
$C_9 = 108 = 50.34\%$	50.00%
$H_7 = 7 = 3.26\%$	3.93%
$O_4 = 64 = 29.85\%$	
$Cl = 35.5 = 16.15\%$	

Action of Alcoholic Ammonia upon Methylmonochlorsalicylate.

By treating this ether with ammonia the object was to displace the *OH* group in the carboxyl with the group NH_2, according to the following equation:

$$C_6\,H_8\,Cl\,OH\,CO\,O\,CH_3 + N\,H\,H\,H = C_6\,H_3\,Cl\,OH\,C\,O\,N\,H_2 + C\,H_3\,O\,H.$$

This change I effected and obtained.

MONOCHLORSALICYLAMIDE

$C_6 H_3 Cl OH CO N H_2$.

Fusing point 222°–223° C.

Produced by heating Methylmonochlorsalicylate with an excess of alcoholic ammonia in a sealed tube. The tube was kept in the oven for twelve hours, it was then removed, and the alcoholic solution strongly concentrated upon a water bath. When the liquid cooled a mass of needle-like crystals separated out.

When pure the compound fuses at 222°–223° C. Very soluble in warm alcohol.

When the alcoholic ammonia was poured upon the ether the liquid assumed a beautiful pale blue fluorescence. Upon heating this entirely disappeared.

Carbon and Hydrogen Estimation.

I. .0510 Grm. substance dried at 100° C. for one hour, gave .0930 Grm. CO_2 = .0253 carbon = 49.5% carbon. Water estimation a failure.

II. 0.1713 Grm. substance dried at 125° C. gave .3041 Grm. CO_2 = .08293 carbon. = 48.41% carbon. And .0554 H_2O = .0061 hydrogen = 3.56% hydrogen.

Calculated per cent.			Found per cent.	
			I.	II.
C_7	= 84	= 48.97%	49 5	— 48.41%
H_6	= 6	= 3.49%		3.56%
O_2	= 32	= 18.66%		——
Cl	= 35.5	= 20.74%		——
N	= 14	= 8.14%		——
	171.5	100.00		

MONOCHLORNITROSALICYLAMIDE.

$C_6 H_2 NO_2 Cl O H CO N H_2$.

Fusing point 192° C.

This compound shows to what extent the presence of the NH_2 group influences the introduction of new radicals. The ordinary monochlorsalicylic acid when treated with fuming nitric acid does not yield nitrochlorsalicylic acid as would be expected, but the carboxyl group breaks up and chlordinitrophenols result. To obtain monochlornitrosalicylic acid the chlorsalicylic acid must be treated with nitric acid very strongly diluted with acetic acid. When chlorsalicylamide, however, is dissolved in fuming nitric acid but one product is obtained—the above mentioned—Monochlornitrosalicylamide. The stability imparted to the compound by the amide group allows the reaction to occur without any decomposition.

After the amide has been dissolved in nitric acid, water is added to the solution, which causes the precipitation of the nitro compound in yellow flocculent masses. These I brought upon a filter, washed well with cold distilled water and then boiled up with potassium carbonate. By strongly evaporating the solution the potassium salt crystallized out. After purification the acid was set free with dilute hydrochloric acid. The acid recrystallized from water showed the constant fusing point 192° C. In cold water it is only slightly soluble and dissolves readily in large quantities of warm water. It crystallizes from aqueous solutions in long, slightly yellow-colored crystals—needles.

The following salts were made and analyzed:

SALTS.

POTASSIUM MONOCHLORNITROSALICYLAMIDE.

$$C_6\,H_2\,NO_2\,Cl\,O\,K\,CO\,N\,H_2.$$

I obtained this by boiling the free acid with a slight excess of potassium carbonate. From the concentrated filtrate the salt deposits in long yellowish-red needles. Easily soluble in water.

Potassium Estimation.

.0460 Grm. air-dried salt were evaporated in a platinum crucible with sulphuric acid. There resulted .0146 Grms. $K_2\,SO_4 = 14.93\%$ potassium.

Calculated per cent.			Found per cent.
$C_6\,H_2\,Cl\,NO_2\,O\,C\,O\,N\,H_2$	= 215.5 =	84.70%	——
+ K	= 39. =	15.30%	14.93%
	354.5	100.00	

BARIUM MONOCHLORNITROSALICYLAMIDE.

$$(C_6\,H_2\,Cl\,NO_2\,O\,C\,O\,N\,H_2)_2\,Ba.$$

I obtained this salt by boiling the free acid with barium carbonate and evaporating the filtrate. The salt crystallizes in short, thick needles, of a deep blood-red color. It is only soluble in a rather large quantity of boiling water.

Barium Estimation.

.2006 Grm. well dried salt were dissolved in water and the barium precipitated as sulphate. Obtained .0805 Grms. $Ba\,SO_4 = 23.66\%$ Ba.

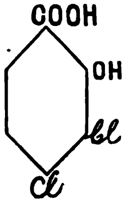
Calculated per cent.			Found per cent.
$C_6\,H_2\,NO_2\,Cl\,O\,C\,O\,N\,H_2$ $C_6\,H_3\,NO_2\,Cl\,O\,C\,O\,N\,H_2$	= 431 =	75.89%	——
+ Ba	= 137 =	24.11%	23.66%
	568	100.00	

DICHLORSALICYLIC ACID.

$C_6 H_2 Cl_2 OH COOH$.

Fusing point 214.

This acid I made according to the method described by Smith, E. F. (American Philosophical Society, Proceedings June 15, 1877.) It formed in rather large quantities along with the monochlor derivative of salicylic acid. The acid was obtained from its barium salt. In cold water it is insoluble, an excess of the boiling liquid being necessary to effect its solution. It fuses at 214° C., and crystallizes from water in arborescent masses. Very soluble in alcohol. The acid is *Parachlormetachlororthoxybenzoic acid* and is graphically represented thus:



That this compound is different from that of Cahours (Annalen der Chemie und Pharmacie—52, 340, 341 pp.), is not only proven by the salts as Smith has done, but also from the fact that the ethers derived from it are not analogous to those published by Cahours.

The ethers I have made were produced in a similar manner to those of monochlorsalicylic acid.

METHYL DICHLORSALICYLATE.

$C_6 H_2 Cl_2 OH C O O C H_3$.

Fusing point 142° C.

I obtained this compound by heating a quantity of silver dichlorsalicylate with an excess of methyl iodide in a sealed tube, the temperature being about 135° C. Upon adding methyl iodide to the salt some action was observed, attended by a decided increase of temperature, the heating in a closed tube, therefore, continued but a few hours. The tube was then allowed to cool, opened and the contents washed with alcohol upon a small filter. In the filtrate needles separated out and were dissolved by adding more alcohol and applying heat. The solution was then evaporated to a small volume and allowed to crystallize, this it did almost immediately.

The crude material fused at 135° C., after pressing the substance well between filter paper, it was again dissolved in an excess of alcohol, from which it afterwards separated in large colorless needles that reflect light strongly.

The fusing point after repeated recrystallizations was discovered to be constant at 142° C.

In alcohol the ether is difficultly soluble. Water decomposes it.

Carbon and Hydrogen Estimation.

0.1974 Grm. dried substance burned with coarse and fine lead chromate, gave 0.3196 Grm. CO_2 = .0830 Grm. carbon = 43.56% carbon; and further, .0551 Grm. H_2O = .0060 Grm. hydrogen = 2.71% hydrogen.

Calculated per cent.			Found per cent.
C_8	= 96 =	43.47%	43.56%
H_6	= 6 =	2.71%	2.71%
Cl_2	= 71 =	32.12%	——
O_3	= 48 =	21.70%	——
	221	100.00	

In the Ann. Chem. Phys. 10. 343, Cahours mentions a methyl dichlorether he obtained by allowing chlorine to act upon methyl salicylic acid.

From boiling alcohol needles of the ether were secured which fused at about 100° C., very considerably lower than the above described compound.

ETHYL DICHLORSALICYLATE.

$C_6\,H_2\,Cl_2\,OH\,C\,O\,O\,C_2\,H_5$.

Fusing point 47° C.

Obtained in the usual manner. From the first alcoholic solution it separated as a dark colored oil, which, after being pressed between filter paper, dissolved in warm alcohol, and upon cooling, the compound separated in beautiful colorless needles. The fusing point was found to be 47° C.

Carbon and Hydrogen Estimation.

0.2072 Grm. well dried substance burned with lead chromate, gave .3418 Grm. CO_2 = 45.51% carbon; and .0808 Grm. H_2O = 4.30% hydrogen.

Calculated per cent.			Found per cent.
C_9	= 108 =	45.96%	45.51%
H_8	= 8 =	3.41%	4.30%
Cl_2	= 71 =	30.21%	——
O_3	= 48 =	20.42%	——
	235	100.00	

Smith first described this compound (Proceedings Am. Phil. Society, June 15, 1877).

Cahours obtained a similar derivative by the action of chlorine upon ethyl salicylate. Broad colorless needles. Fusing point not given.

ISOBUTYL DICHLORSALICYLATE.

$C_6 H_2 Cl_2 OH C O O C H_2\text{–}C H (C H_3)_2$.

Fusing point 188°–190° C.

In the case of the monochlor acid the production of this derivative was not attended with success. With the dichlor acid the formation of the isobutyl compound followed without any difficulty, the usual method being employed, viz.: heating the silver salt and isobutyl iodide in a sealed tube at 150° C. The contents of the tube were treated with alcohol, thus dissolving the new compound. The alcoholic filtrate was evaporated almost to dryness and put away in a cool place. In the lapse of a couple of hours the liquid in the beaker had solidified. The mass was removed from the vessel, thoroughly dried between filter.paper, removing in this manner the greater portion of adherent isobutyl iodide, then dissolved in alcohol and allowed to crystallize. Warty-like masses appeared of fine, minute, almost colorless needles. In alcohol the compound is exceedingly soluble. In pure water, even when boiling, it was discovered to be almost insoluble, decomposing after a time.

To extract the compound, cold water was added to a concentrated alcoholic solution. This was done several times and the compound then crystallized from a mixture of alcohol and water. It crystallizes in needles, fusing at 188°–190° C.

An analysis yielded the following results:

Carbon and Hydrogen Estimation.

0.1190 Grm. dried substance burned with lead chromate, gave 0.2200 Grm. CO_2 = 0.06 Grm. carbon = .5042% carbon. Further .0525 Grm. H_2O = .0058 Grm. hydrogen = 4.87% hydrogen.

Calculated per cent.			Found per cent.
C_{11} =	132 =	50 19%	50.42%
H_{12} =	12 =	4.56%	4.87%
Cl_2 =	71 =	27.00%	——
O_3 =	48 =	18.25%	——
	263	100.00	

ACETYL DICHLORSALICYLATE.

$C_6 H_2 Cl_2 OH C O O CO C H_3$.

With the monochlorsalicylic acid I had no special trouble to obtain this derivative, but with this acid the most careful work apparently failed to yield it. The material employed to effect its formation was perfectly pure.

I invariably obtained a product, but this when purified and analyzed, gave results that indicated the compound was nothing more or less than the original dichlorsalicylic acid.

Unless the alcohol which I employed as a solvent for the compound caused the decomposition of the latter, I am at a loss to know to what my failure to obtain it should be ascribed.

Both the mono and dichlor acids were acted upon by benzoyl chloride, but as I have not yet ascertained anything positive in regard to the resulting compounds, statements of their properties, &c., are withheld for the present.

DICHLORSALICYLAMIDE.

$$C_6 H_2 Cl_2 OH C O N H_2.$$

Fusing point 209° C.

The same course was pursued here for the obtainment of this compound, as has already been described under the heading of *Action of Ammonia upon methylmonochlorsalicylate.* The heating in a sealed tube was continued through twelve hours. The temperature never extending above 100° C. The contents of the tube removed and evaporated, deposited small nodular crystals. These upon recrystallization became perfectly white in color, but retained the form of the nodules, which appeared to be composed of densely united needles. The compound dissolves readily in alcohol. The pure compound fused at 209° C. It was not subjected to a combustion.

The fluorescence that was exhibited when alcoholic ammonia was poured upon the methylmonochlorsalicylate, was not near as beautiful as that observed in this case. Heat caused its disappearance.

By comparing the results of this investigation with similar derivatives of ordinary salicylic acid, the evident stability shown by most of the ethers of mono and dichlor salicylic acids, will not fail to be observed, and the cause for this seems to be due to the presence of negative chlorine, since this apparent stability shows itself from the moment of its introduction. Of the four ethers obtained from the monochlor acid, two, the ethyl and isobutyl derivatives appear to lack the decided crystalline character exhibited by the rest. With the dichlorine compounds the acetyl is the only one that has indicated any signs of non-stability. A comparison, too, of the salts of the different acids, shows the influence exerted by the presence of chlorine. All are fine crystalline compounds.

TABULAR VIEW OF MONO- AND DICHLOR-SALICYLIC ACIDS AND THEIR DERIVATIVES.

Monochlorsalicylic Acid. $C_6H_3ClOHCOOH$. (Hübner & Brenken.)	172°	Long colorless needles, readily soluble in water.	$(C_6H_3ClOHCOO)_2Ba + 3H_2O$. Colorless shining plates. Easily soluble in water. (Marshall.)	$C_6H_3ClOHCOOK$. Long colorless needles Very soluble in hot and cold water. (Marshall.)	$C_6H_3ClOHCOONa$. Short straw-colored needles, easily soluble in water. (Marshall.) $C_6H_3ClOHCOOLi + 2H_2O$. Large colorless, broad plates. Rather soluble in water. (Marshall.)
		$C_6H_3ClOHCOOCH_3$. Fuses 48° C. Long colorless needles rather soluble in alcohol. (Marshall.)		$C_6H_3ClOHCONH_2$. Fuses 222°-223° C. Needles soluble in warm alcohol. (Marshall.)	
		$C_6H_3ClOHCOOC_2H_5$. Fuses 110° C. Stellated masses. (Marshall.)		$C_6H_2NO_2ClOHCONH_2$. Fuses at 192° C. Slightly yellow colored needles. Soluble in water. (Marshall.)	
		$C_6H_3ClOHCOOC_4H_9$? (Marshall.)		$C_6H_2NO_2ClOKCONH_2$. Yellowish-red needles. Readily soluble in water. (Marshall.)	
		$C_6H_3ClOHCOOCOCH_3$. Fuses 149° C. Acicular masses soluble in alcohol. (Marshall.)		$(C_6H_2NO_2ClOCONH_2)_2Ba$. Short thick needles. Red in color. Soluble in a large quantity of boiling water. (Marshall.)	
Dichlorsalicylic Acid. $C_6H_2Cl_2OHCOOH$. (Smith.)	214°	$C_6H_2Cl_2OHCOOCH_3$. Fuses 142° C. Long, colorless needles. Difficultly soluble in alcohol. (Marshall.)	$C_6H_2Cl_2OHCOOC_2H_5$. Fuses 47° C. Colorless needles. (Smith.)	$C_6H_2Cl_2OHCOOCH_2{-}CH(CH_3)_2$. Needles fusing at 188°-190° C. (Marshall.)	
				$C_6H_2Cl_2OHCOOCOCH_3$-? (Marshall.)	
			Colorless needles, fusing at 47° C. (Marshall.)	$C_6H_2Cl_2OHCONH_2$. Fuses 209° C. White nodular crystals soluble in alcohol. (Marshall.)	

THE TIMUCUA LANGUAGE.

BY ALBERT S. GATSCHET.

(Read before the American Philosophical Society, April 5th, 1878, *as a sequel to the article read April 6th,* 1877.)

Ancient writers on Floridian history have left us a multitude of interesting details of the civil life and warfare of the Timucua. But these newcomers often judged these and other natives and their peculiarities with the bias and prejudice inseparable from their European origin, and many of their views may, after a comprehensive study of the Southern tribes, finally prove untenable. Nothing conveys so deep an insight into the mode of thinking and the mental capacities of a people than its idiom, and though it will not enable us to correct inaccurate or erroneous historical statements, it will depict to us an important side of the interior life of the nation, disclose its social and intertribal position, give a glance at its ideas on religion, demonology, or natural phenomena, and perhaps furnish indications of former migrations.

The volumes of F. Pareja consulted by me are the property of the New York Historical Society, and to the courtesy of its librarian, Mr. J. A. Stevens, I am indebted for the opportunity of perusing also some passages, which contain the titles of other books published in Timucua by the Padre. They mainly refer to ascetic subjects, and in the "Historical Magazine of New York," 1858, No. 1, page first, the *second* edition of a Timucua Catechism is mentioned, which was printed by Juan Ruyz in the City of Mexico in 1627. A copy of it exists in the Library of the British Museum. The title of one of Gregorio de Mouilla's books is given below.

To a further selection of Timucua texts I premise here a few notes of historical and linguistic import.

VARIOUS NOTES.

1. Although the people and language of which we treat is generally called *Timuquana,* I have preferred the simple form of *Timucua,* by which term the tribe seems to be characterized as the ruling or most powerful portion of the entire oligarchic commonwealth. Timuquana is only the Spanish *adjective* of the noun *atimoqua* or *atimoqe,* and occurs in "lengua timucuana, provincia timuquana," while Pareja and the historians always give Timoqua, Timuca or Timucua, as the real name of the district and tribe. The French formed their "Thimagona" from the Spanish adjective.

2. Mr. Buckingham Smith, in a manuscript note, gives the following about the *area of the Timucua language:*

"The limits within which the language of the Atimuqua was spoken can be stated only in general outline. On the north the boundary was not distant from the river Saint Mary's, on the west the river Ausile and the

Gulf of Mexico limited it, and with some irregularity it extended nearly to Tampa Bay; on the east the boundary was the ocean, whence it followed the shore line to the northward above the nearest limit of Georgia. The exception to this circumference was the territory lying east of the St. John's river, beginning about eighty miles from its mouth and approaching near the river Mayaimi; this section was occupied by a separate people, the Aisa."

To this description of the area, which is perhaps not far from the truth, I would add the fact, that the name Ibitachuco, given in my first article as the name of an Apalache place, is taken from the Timucua language and means "Black Lake."

3. The system and terminology of Timucua consanguinity are coinciding with the system in use with the Pawnees, as delineated by Mr. Lewis H. Morgan (Consanguinity, pages 196, 245). Among the texts given below, those on Timucua lineages and their terms of kinship will be of the highest interest. In the selection of linguistic specimens I was careful to pick out such as contained none or few abstract ideas, for concrete terms are of greater help in the elementary study of a tongue than abstractions. The status of the texts requires a critical, sifting treatment, and to this circumstance is attributable the paucity of the specimens here offered.

4. The principal difficulty in acquiring the Timucua idiom is the same which we have to overcome in the Maskoke dialects and in other Southeastern languages. It is the multiplicity of the suffixed pronouns and adverbial particles, their combinations and various uses. These pronouns and particles, which Rev. Cyrus Byington has in the Chá'hta called article-pronouns, are not, as they are there, parceled up into simple vowels and consonants, but according to the phonetic rules of Timucua generally form a whole syllable. But the vowels in them constantly change and, less frequently, the consonants. This renders them and their combinations of difficult identification; but to disentangleand clearly understand the texts, this obstacle has to be surmounted.

PEDIGREES AND TOTEMIC DESCENDENCIES OF THE TIMUCUA.

In reading Pareja's catalogues of the families and totems of this Floridian people, the exclusiveness and aristocratic character of the European chivalry with its picturesque heraldry, spontaneously suggests itself for comparison. The prohibition of intermarriage between certain lineages finds many analogies among the customs of North American and foreign tribes. We cannot always conclude from similar facts, that the subjection of various tribes, which were incorporated into the nation, was the cause of this prohibition; here it is certainly more admissible to imagine, that endogamic marriage had prevailed in the nation from pre-historic epochs down to Pareja's time.

In Father Pareja's writings the interesting catalogue of tribal lineages follows the enumeration of relationships given in my former article, page 9, and then he continues:

(First Catechism ; sheet I.)

There are many other terms for degrees of kinship, too prolix to be given here, and I therefore mention only the most important. In the following lines I will mention some of the principal lineages found in every part and province of the country, though sometimes occurring in a different shape, and I begin with the pedigrees of the upper chiefs and their progeny.

The upper chiefs (caciques), to whom other chiefs are subject, are called *ano parucusi holata ico* (or: *olato aco*, or: *utinama*). From this class comes a councillor, who leads the chief by the hand, and whose title is *inihama*. From him comes another class, that of the *anacotima;* the cacique seeks the advice of these second councillors, when he does not require that of the *inihama*. Another caste descends from the *anacotima;* it is that of the *second anacotima*, and from these the *afetama* derive themselves. Another class (of councillors) usually accompanies the *inika*, who forms the first degree after the head-chief; this class is the *ibitano* class. From the *ibitano* a line proceeds, that affords councillors ; this line is called *toponole*, and from them spring the *ibichara*.

From the last named proceed the *amalachini*, and the last lineage that traces its origin to the head chief, is *itorimitono*, to which little respect is paid. But all the other classes, mentioned before this last, are held in high consideration ; they do not intermarry among themselves, and although they are now Christians, they remain observers of these caste-distinctions and family pedigrees.

Of a further line derived from the upper chief all members call and consider each other as "cousins." This is the line of the White Deer, *honoso nayo*. In the provinces of the "Fresh Water" and Potano, all these lineages emanating from the chief are termed people of the Great Deer, *quibiro ano*. Families sprung from former chiefs are : *oyorano fiyo chuluquita oconi*, (or simply) *oyolano*.

The lower pedigrees of the common people are: the "Dirt (or Earth) pedigree," *utihasomi enatiqi;* the Fish pedigree, *cuyuhasomi*, and its progeny, called *cuyuhasomi aroqui, cuyuhasomiele*, while its progenitors are termed *tucunubala, irihibano, apichi*.

Another strange lineage is that of the Buzzard, *apohola;* from it descend those of the *nuculaha, nuculahaquo, nucula-haruqui, chorofa, usinaca, ayahanisino, napoya, amacahuri, ha-uenayo, amusaya*. These lineages all derive themselves from the *apohola* and do not intermarry.

Still another pedigree is that of the *chulufichi;* from it is derived the *arahasomi* or Bear pedigree, the *habachaca* and others, proceeding from this last.

From the *acheha* derives itself the Lion family or *hiyaraba*, the Partridge line or *cayahasomi*, and others, as the *efaca, hobatine quasi, chehelu*. In some districts these lineages are of low degree, while in others they rank among the first, and since it would be mere loss of time to give more, the above may suffice. These latter castes already prize much higher the names and pedigrees of Christianity, for the divine glory descends on them, when they receive their names at the baptismal font.

TERMS OF RELATIONSHIP USED INDIFFERENTLY BY MALES AND FEMALES.

(First Catechism, from page G, iii verso, to page G, V recto.)

Father and mother in speaking to their son say *chirico viro, ahòno viro* and to their daughter, *chirico nia, ahono nia.* Uncle and aunt address their nephews and nieces by the same terms, as if they were their own children. The true terms for nephew and niece I have given above.

The one who procreated me, *ni siqisama;* my father, *itina.* After his death they do not call my father *itina,* but they say: the one who procreated me, or from whom I came, which is *siqinona.* A father deprived of his children by their death, *naribua-pacano.*

Thy father *itaye,* his father *oqe itimima,* our father, *itinica, itinicale, itinicano, itimile;* your father *itayaque,* their father *oqecare itimitilama; itimilemala.*

My stepfather *itorana* or *itorina,* thy stepfather *itoraye,* his stepfather *itorimima;* our stepfather, or: he is our stepfather *itorinica, itorinicale, itorinicano;* your stepfather, or: he is your stepfather *itorayaque;* their stepfather, or: he is their stepfather *itorimitilama, itoramilemala.* The second stepfather (padrasto de los dedos que en latin se llama *redubia*) *hue sipire,* or: *hue asire.*

Mother in general *isa;* mother of children living *ano-ulemama;* mother without children or kindred *yache pacano.* My mother *isona;* after her death, not to revive the painful memory of it, they do not use this term, but say: she that gave me milk, or she that was my breast, *iquinena;* she that was thy breast, *iquineye.* She being present, or at seeing her approach, they say: is she thy mother? *isaya?* or: *isayente?* Did thy mother do this or that? *isayesa* (for: "isaye isa")? Does thy mother say this or that? *isayeste?* Thy mother does not wish, *isaye iste.*

His mother *isomima;* she that gave him milk *iquinemima.* Our mother *heca isomile,* or: *heca isonica;* she that gave us milk *iquinemile.* Your mother *isayaqe;* she that gave you milk *iquineyaqe.* Their mother *isomitilama;* she that gave them milk *iquinemitilama.*

Grandfather, stepfather, godfather, *itora, itori elcai,* or: *paman.* My grandfather, my stepfather, my godfather is rendered by terms similar to those given above, through all the persons, f. i: my grandfather *itorina,* thy grandfather *itoraye.* etc. Great grandfather *itora naribua,* or: *coesa itora;* great-great grandfather *itoramulu.*

Grandmother, stepmother, godmother, *nibira;* great grandmother *nibirayache, isayache;* great-great grandmother *nibirayachemulu.*

Uncle on father's side *itele;* thy uncle, or mother's: *nebaye.* After his demise, the niece or nephew refer to him only by the term *naribuana,* "my old man," and so do others in speaking to them. Uncle of my uncle *nebua naribama, nebua nebemima.* Aunt on the father's side, *nibe;* on the mother's, *isale;* my aunt *nibina,* and when on the mothers' side *isalena.*

After the mother's death her child calls the uncle no longer *nebena,* but by the term grandfather, *itora,* which is then also bestowed on the father. After the father's death the child calls the aunt, on father's and on mother's side, *nibira,* the name of the grandmother. In this manner, a person ignoring the death of either parent, often understands that the grandparent is spoken of instead of the person that is meant.

Father-in-law, or mother-in-law: *ano nasimita;* together they are called *ano nasimitachique.* Son-in-law *nasi;* my son-in-law *nasina,* thy son-in-law *nasiye,* his son-in-law *nasimima;* our son-in-law *nasinica,* our sons-in-law *nasimile carema,* your son-in-law *nasaye,* your sons-in-law *nasiyaqe,* their son-in-law *nasimitilama;* daughter-in-law *nubo*; father-in-law or mother-in-law *ano nasimitama.*

Should the father die, the child ceases to call the mother by her proper name of *isona,* but calls her grandmother *nibira,* and if the mother die, the child calls the father no longer *itina,* but grandfather, *itora,* and the uncle on the father's side it also calls *itora.* On the death of the husband, wife, or of a relative, the parent calls the children *piliqua,* and they among themselves cease to call each other as formerly, but say *piliqua* or *hiosa.*

The sons of brother and of sister call the children of their uncle *quiena,* and his children call those of his sister *ama, eqeta* or *aruqui,* the term for second cousins, who are also called cousins, *qisotimi.*

TERMS OF RELATIONSHIP USED BY MALES ONLY.

(First Catechism, first pages of sheet H.)

My child (son or daughter) *qiena;* my elder child *qiena miso;* intermediate child *pacanoqua;* my younger child *qùyanima;* last child *yubuacoli,* my last-born child *quiani cocoma;* the very last child (el hijo, la hija que sale a las hezes) *isicora, isinahoma.*

For all this another mode of expression exists, that is more used in the interior, as follows:

My son, *ahono viro;* my daughter, *ahono nia;* my elder son, *ahono viro misoma;* my elder daughter, *ahono nia misoma;* my intermediate son, *ahono viro pacanoqua;* my intermediate daughter, *ahono nia pacanoqua;* my younger daughter, *ahono nia quianimu;* my last son, *ahono viro iubuacoli,* or: *ahono viro quiani cocoma;* my last daughter, *ahono nia iubuacoli,* or: *ahono nia quiani cocoma;* my very last son, *ahono viro isicora, ahono chirico, ahono chirico isinahoma.*

Daughter-in-law (this is used by both sexes) *nubuo;* my daughter-in-law *nubuona;* she calls her father and mother-in-law *nubuomitana,* or: *ninubemitama.* Brother-in-law *yame,* in the Timuqua province they say:

yamanchu, or : *yamenchu*. The husband says to his sister-in-law *yamemitama*, she says to him *tafimitama*, my brother-in-law.

Elder brother *niha* or : *hiosa*. When chiefs are brothers or equal in power, to equalize their consideration they are called or call each other by this term *hiosa*. The elder brother calls the younger brother and the younger sister *amita, amitina*, or : *yacha quianima*, and his elder sister he calls *yacha miso*. Should the younger brother die, the elder never says that he is dead, and never calls him, as formerly, *amita* or *amitina*, but speaks of him as *yubuaribana* "he that was born after my younger brother ;" and when the elder brother is dead, the younger names him no longer *hiosa* nor *niha*, but only *ano ecoyana*.

Of twins, boy and girl, the male is called *caru amitimale*, "brother born at a time with a sister ;" the female is called *caru yachimale*, "she that was born with a brother."

My male or female cousin (speaking to males) *conina;* thy cousin *conaye*, his cousin *conimima*, our cousin *coninica, conimile*, your cousin *conayaqe*, their cousin *conimitilama*. My male or female cousin (speaking to females) *ebona, ebuona;* thy cousin *eboya, ebuoia*, her cousin *ebuomima*.

The cousin calls the wife of his uncle *nebapatami, torapatami, itorapatami, entena* or : *entenada qisotimi*. Of the sons of two brothers, those of the younger call the uncle the same as if he were their father, *ite miso*, those of the elder call the uncle, who is the younger of the brothers, *ite quiani;* otherwise the uncle of either is called by them *itele*. The sons of these brothers, although they be second cousins, call each other "brothers," observing the foregoing nomenclature, and the daughters of these brothers call the elder cousins *yacha*, the younger *amita, amitina*, and also by the terms given above. The common people call these children of brothers, when male : "brothers," "born together :" *viro amitimale siqe*, or "reared together," *viro amitimale pocha;* and when male and female, they are called *yachimale*. When two brothers marry two sisters, they each call the other *tafi*, the term for brother-in-law and sister-in-law, and should the men not be of kin they are called *yame*, "married to my sister," or *iquilnona*, "married to the sister of my wife." The children of different fathers by the same mother are called *ano nemoquareqe siqe;* if male, *viro nemoquareqe siqe*, if female *nia nemoquareqe ulemi*.

TERMS OF RELATIONSHIP USED BY FEMALES ONLY.

(First Catechism, sheet H.)

My child (son or daughter) *ulena*. Is it thy child? *ulaya?* It is her child, *ulemila*. Is it her child? *ulemima?* The child of Maria, *Maria ulemima;* the son of Maria, *Maria ulemila*. It is our child *ulenica* or *ulemile;* your child *uleyaqe;* their child *ulemitilama*. The children of Anna, *Ana ulemicare ;* my elder child *ulena miso ;* my second child *ulena paca*-

noquana; my younger child *ulena quianima;* the fourth child *quiani cocoma;* my very last child *yubuacoli* or *isicora.*

The niece calls the husband of her aunt *itora,* "grandfather." My brother's wife *ni quisa;* she calls the sister of her husband *ni quisimitana,* and the brother *tafimitana, ni tafimitama.*

My elder brother *poyna misoma,* my younger brother *poyna quianima;* my elder sister *nihona,* my younger sister *amitina, amita oroco;* in Potano and Icafi *chirima* is used instead: *amita chirima, amita chirico.* In Timoqua the women say to their sisters, and the men to their brothers *anta, antina;* and when the younger speak of the older brothers they employ the terms used here by the coast people: *hiosa, niha.*

My last sister *yubuacolima,* my aunt, sister of my mother *isale;* the sister of my father *nibina;* my nephew on brother's side *ebona,* on sister's side *ulena,* the same as "my own child." Is it thy nephew or niece? *eboya?* When a nephew on the brother's side dies, he is called *anetana, ano etana,* and not *ebona;* but if the deceased be of the sister's side, he is called *ano nihanibama* or: *aymantanica;* and if any child of his die the deceased is called *ano nihanema* or: *aymantana.* The males likewise apply this term *aymantana,* same as the females, to a deceased near relative whom they dearly loved; and if he should be a chief, he is called by everybody *aymanino neletema.*

My daughter-in-law *nubuona;* a daughter-in-law calls her husband's father and mother *nubuomitana* or: *ni nubuomitama.* Son-in-law or daughter-in-law *quisotina;* the stepmother calls him or her *ulena,* "my child." The husband of a woman's cousin is called by her *nasi,* "son-in-law," the wife is called equally by both sexes *nubuo,* "daughter-in-law." The children of sisters are called brothers and sisters, in observance of the nomenclature above given. Children of the younger sisters call their aunt *isa miso,* "elder mother," and children of the elder sisters call their aunt "younger mother," *isa quianima.* The woman calls all the children of her sister alike, *evona,* and the brother calls them *conina.* If they are sisters, they call the children of their uncle *evona,* and his children call her nothing less than "mother;" but if the children of the sister be male they call the children of their uncle *quiena,* viz.: "my children," although they are cousins. The children of the brother call the children of their aunt *ama* or *equeta,* although they are first cousins. The aunt or uncle, the father or mother of the nephew or niece being dead, these are called *piliqua* only, which term is used by others towards those who are without any relative, or have neither father nor mother. And the son of the brother calls his aunt *nibina;* the nephew on the mother's side calls his uncle *isale, isalena,* "my new mother, or aunt." Those who are of the same house, lineage, or parent by the female side are called *ano quelana* or *anona,* "my relative."

When the wife dies, the surviving husband says: "my fire is out" *taca ni timutema;* "he is dead who sat near me," *uquale hibuano nirocosema.* If a woman's brother die, she says: *ano viro nirocosema,* "that man that

I lost;" and if a sister die, she says: *ano niami nirocosema*, "she, my personal friend, that died."

COMPREHENSIVE TERMS OF RELATIONSHIP, USED BY BOTH SEXES.

(First Catechism; sheet H; page V verso.)

The great-grandfather and the great-grandson, *itora naribua muulmale;* the great-grandson and the great-grandfather *qisitomale.* The grandfather and the grandson *itorimale,* the grandson and the grandfather *quisitomale.* Husband and wife or wife and husband, or male and female of any description *inihimale,tacamale;* this latter is not applied to beasts, however. Father and son *itimale,* son and father *qimale, siqinomale.* Mother and daughter *isomale,* daughter and mother *ulemale.* Uncle and nephew *itelemale,* nephew and uncle *qiemale,* same as "son and father;" uncle and nephew *itemisomale,* when the uncle is the elder brother of the nephew's father. Sister and brother *yachimale;* brother and sister *poymale.*

(Follows the series given in first article, page 7.)

INTERROGATORY BEFORE BAPTIZING A NATIVE.

(First Catechism, sheet A, page iiii.)

My son, are you a Christian?	Quiena, chi Christiano?
No, I am not a Christian, my Padre!	Ya, ni Christianotila, itina!
My son, what is it then you want and require?	Quiena, hachibonoco chi mante, hachibueno lapuste cho?
I want to be a Christian.	Christianolesiro ni mantela.
Do you come with the real desire of becoming a Christian?	Nocomicoco Christianoleqi manta pona cho?
Yea, I come here truly desiring (to be such).	O, nocomicoco manda ni ponola.
How do you wish to be called?	Visamano hachamuenolesiro chi mante?
I want to be called Peter.	Pedro muenolesiro ni mantela.
I want to be called Mary.	Maria muenolesiro ni mantela.
What do you request of the Church?	Iglesiama hachibonoco lapueste cho?
I request (of it) the belief in Jesus Christ, (that is) to believe truly in God.	Fèmonoma Jesu Christo, Dios nocomi bohono acoma, lapustala.

To give me the everlasting life.	Balunu nanemima nohohauela.
This belief, to believe truly in God, it will give you!	Caqi Fèmono, Diosi bohono acoma, achibueno cho hohaue!

INTERROGATORY BEFORE BAPTIZING INFANTS.

(First Catechism, page before sheet F.)

I. *One Infant only to be Baptized.*

What do you bring into this House of God, into Church, a male or a female infant?	Caqi Diosi pahama, Iglesiatema, hachaqueneco uquata pona chica? viroma? niama?
I bring a male infant!	Viroleqe uquata puenonicala!
I bring a female infant!	Nialeqe uquata puentanicala!
What does it require to be?	Hachaquene siro mante?
It wants to be a Christian.	Christianolesiro mantela.
By what name is it to be called?	Visamano hachamuenolehaue?
What does it request of the Holy Church?	Sancta Iglesiama hachibono lapuste?
It requests the belief in God.	Fémono Dios bohonoma lapustela.
Which belief in God will (the Church) give to it?	Fèmono Diosi bohonoma hachibonoco ohohaue?
It has to give to it everlasting life.	Balunu nanemima ohohauela.

II. *Several Infants, Male and Female, to be Baptized.*

Do you bring into this house of God, into Church, male or female infants?	Caqi Diosi páhama, Iglesiatema, hachaquene careco uquata puena chica, viro carema, nia carema?
I bring male and female infants.	Viro niaquene care uquata puenonicala.
What do they require to be?	Hachaquene siro mantama?
They want to be Christians.	Christianolesiro mantamala.
By what name are they to be called?	Visama hachamueno mohaue?
What do they request of the Holy Church?	Sancta Iglesiama hachibono lapustama?
They request the belief in God.	Fémueño Diosi bohonoma lapustamala.
Which belief in God will (the Church) give them?	Fémano Diosi bohonoma hachi buenoco ohobohaue?
It has to give them everlasting life.	Balu nanemima ohohauela.

CONFESSIONAL INTERROGATORIES.

(Confessionario, pages 198 r., 208 v., 209 r.)

Did you cease fasting on the regular fasting days?	Itorino-lehaue equelacoma itorinoma hanibicho?
Did you eat meat on days when it is prohibited?	Soba heno-lehaueti equelaco sobaebi cho?
How many times a day?	Equela yahaheno chuqua?
For eating or drinking to excess did you get unwell?	Hono heta nacuta na inibitisote chiqua iqilabosobi?
Did you inebriate yourself by drinking to excess?	Hachibueno lehemosico heta ucuta na inibitisota mosotabocobi cho?
Without feeling hunger (or thirst) did you eat or drink to excess?	Maninoticote heta ucuta ebelecasota mosobi cho?
Have you murdered anybody?	Anoco iquenibi cho?
Did you desire anybody's death?	Anoco nihihero manibi cho?
Have you beaten anybody with a stick?	Anoco abotobi cho?
Have you loathed anybody?	Anoco putuobobi cho?
Did you counteract anybody's interests?	Anoco namoyo cosinibi cho?
Had you a grudge against any one, or did you persecute him?	Anoco naenamiro mosota alihota mosobi cho?
How often did you do this?	Chuqua lehaue chuquosa cho?
Did you scoff anybody by making him the object of derision?	Anoco una nantereqe matita istico hiobobi cho?
Did you insult anybody by calling him a sodomite?	Anoco iquitimosota matita poranacu yubanala mueno-leheco monobi cho?
On last Lent did you confess?	Cuaresma yoquana pirama orobinibi cho?
Have you not loved God?	Diosi hubuasotanatila?
When somebody was crazed, did you believe what he said?	Isucu echa hebuatema nocomile manda bohobi cho?

(Confessionario, pages 205–207.)

Do you believe firmly in the Lord, in all the articles of God's faith, and in the supreme law?	Nocomicoco atichicoloye atimoqua, cumenabacata Diosima bohacocoleta, naqua mine hebuano cumelenima bohote cho?
Do you love God more than anything else?	Hachibueno inemi ofuenoma Diosimaqua hubasote cho?
Against the law of God did you proffer curses or evil words?	Diosi hebuano nemoquamima emoqua ecata istico hebuata, mane manemati, hebuabi cho?
Have you father and mother?	Itimi isomiquene chi nahe?

Did you wrangle with your father?	Iteye icasinibi cho?
Did you beat your mother with a stick?	Isaye abotobobi cho?
Have you abused them by evil words?	Iquitimoni hemosi na hebuasibota na istico hiobota mosobi cho?

QUESTIONS TO SORCERERS AND HERB-DOCTORS.

(Confessionario, pages 131 and 210.)

Have you prayed over the new maize?	Holabaca qibema ituhubi cho?
Did you see through the sorcerer's tricks if war is to come on?	Iri imetaheco manta yalacota enemibi cho?
In which way, and by means of which herb do you do this?	Naquostanaye, nie chaqueneco isotana hiabote cho?
Did you search any object lost by the Demon's artifice?	Hachibueno chebeqe hiti isonoma isota yalacobi cho?
What you are doing to make reappear what is lost and that you say: "it is here, or it is in such a spot, or he stole it?" all this the Demon tells you in order to get hold of your soul; do not believe in him, let it go, for this is a great sin.	Hachibueno chebuamano hochie nacu china hiaboheleqete hitima chajo staqe qebeta fateno motaqe chistela, qebeta uquateno; motaqe chistela mine hitimano, naquostequa atichicoloye uquasiro manda isotela, bohosetiquani hache, naquosatiqua inti acola.
Did you produce rain?	Uquisa hibuabi cho?
If God will not, it will not rain, whatever you may do.	Uquisono manta itufa cocolenocote Diosima manetileqe uquiheleqete.
Stop doing this, for it is a great sin.	Haniha chenaqua inti acoleqe, chisisotanano.
Are you a herb-doctor?	Chi isucu?
Did you cure anybody imperfectly in order to make him come back to you, that he may reward you better?	Ano orobonoma hachipacha nahumequana anoco orobobi cho?
Did you cure anybody with the prayer and incantations of the Devil?	Aribua orobotanaye iquilabono eyo-leheco ituhuta polesibi cho?
Did you bewitch anybody?	Anoco orobasobi cho?

CHIEFS AND OTHERS ADMONISHED AGAINST WITCHCRAFT.

(Confessionario, page 130 v., etc)

Do not believe or trust in any manner, that you have to hunt with the aid of Demon's prayer, unless he prays the prayers of God; and when God is served according to his will, you shall hunt the game; you can	Caqi ituhunuma hiti hebuanomano hanta, acu caqi inino istico carema hanta chale caqua quoso hache caqi anopira cumeleta na ine toomama iquimileqe iquentahale manda bohatiqua ni hache Diosima-

hunt after having relinquished the ceremony of the Demon, committing (the chase) to God.	riqena chi iquenta-hauela Dios ituhunuma ituhunulebila.
After being cured by the doctor and having become reconvalescent, did you prepare food of a sort of cakes or fritters ("de tortas ó gacha") or of other things and did you halloo to the doctor "that he cured you," supposing that if you did not do so, the disease would reappear?	Iquilabo chique isucuma chorobotequa chibaleqe, chi isuqustanimano hono inonta pesolo-leheco, holaqitino-leheco, nachiqisi chiqe mine usucumano anobe-lehaue yanacu iqilabonoma acuna hacu niqilabohauele manda mota bohobi cho?
Did you order that the bones of the game must not be thrown away, unless the game would no longer enter into the snare or trap, but that they must be hung up or placed upon the roof of the house (en las palmas de la casa)?	Hachipile uquestanaye yabima ichuquinctiqua nimaca, uquesinoma ubua-hauetila mota bohota mosobi cho?
Before hunting some antelope did you take the antlers of another antelope and pray over them the Demon's prayers?	Nimota uquata ituhuta honosoma enesota onaquosta, ituhuta iquenihale manda bohobi cho?
You must abandon with the force of your will all (pagan) ceremonies, superstitions, auguriums, dreams, sortileges, cursings, maledictions, visions and lies, for all these things have been taught by the Devil, who is the father and root of the lie, to your ancestors and to your priests; and after you have rejected all these things by the force of your will, you must embrace the law of God and take up all its precepts.	Naquenele andaqua hebuano hiti hebuata ano iquiyaqe ohotaui michunu hanta hachibueno ineco, nahiheco iseco, nahiheco mosileque, hachi ninasisala manta, yabisacatala manda, bohonoma bohatiqua, nihiqui nolehecote hachibono caresino nayelebinaqeco bohatiqua nuraboqui manetiquanta naquenema nurabono mulu siqisostema hitima nantaqe nurabono itimila hitimano, naqueneqe nurabotemano hitima hebuutaqe isinola.
All of it must be believed and observed.	Acu caqi bohono-letahaue, yaleno-letahaue.

QUERIES AT THE NUPTIAL CEREMONY.

(First Catechism, sheet F, page v.)

(Priest.) Maria! do you want this Pedro for your legitimate husband by actual declaration, as our mother, the Holy Catholic Apostolic Roman Church, requires it, and will you declare it by saying so?	Maria, caqi Pedro iribotema naquenihaue cocomano heca isomile Sancta Catholica Apostolica Iglesia Romanoma mantaqe hebuano, caqita isinoletema betaleqe hibuastala mote cho?
(Reply.) Yes, I say so.	O, motala.

(Priest.) Do you consent to have her for your spouse and wife?	Minete ni nia mitota nihibuasala mote cho?
(Reply.) Yes, I consent.	O, motala.
(Priest.) Do you accept him as your promised husband?	Hotosinta inifinano manta habosote cho?
(Reply.) Yes, I accept him.	O, habosotala.

EBRONIUS PUNISHED FOR HIS CRUELTIES.

(Confessionario, page 81 recto and verso.)

In the sea of Lyons, on the island of Barbaria, a monk, after having said the morning missa, perceived a vessel which seemed to fly rather than to move on the waters. He heard in it great shouting of people; when the monk inquired with loud voice, "who they were?" a voice replied: "We are demons, and we hold on board of this vessel Ebronius, the powerful mayordomo of the royal house of France, and we will disembark him, and throw him into Vulcan's furnace (olla), and torture him there forever for the wrongs which he inflicted to thee and to others, while he went on without being sorry for it and showing no mental distress nor contrition about his detestable deeds." The monk noticed the hour (of this occurrence) and afterwards discovered with entire accuracy (verdad) that at the same moment Ebronius would die at the royal court. Ebronius banished the monk upon that island and ordered one of his eyes to be cut out. And to another monk he ordered both eyes to be removed, imprisoned him and let him perish in prison. For similar misdeeds he finally met in hell the reward which he had deserved.

Leon mocama, paqi Barbaria mononco, itimilenota hibatequa maytines ofonoma iniqe enenincono ticopaha iquo inibitileta osobononco maha iribite acoleta ibine ofonoma mitetichu mota mitaqe ano chocolo hebanconoso omotaqe ita-itaqe itimileno michunu: "iquasibota chita cocarente chica?" masibota yechiboque isimonimano: "caqi ticopahamano Ebronio, Francia hachi-ena anocoma echesota hotanicala hachinaramino pahama echesota, nanemi isticosota hachinaramisota habeletanicala caqi calubonimano hochie echisonimaqui acuyoquama isonimateqene eyoma isotanimate-quenema betaleqe, inela naquenema nahiabonta cumeleta chaca niquintele manta na anolatile nimabetaleque inela mopuenoqe ocotota caqueteleqe." Isenela manta na hiabotequa inta haninco mantequa iniqe eneni michu cocoma nihiqe naquene chuletoma ninimano. Caqi Ebroniomano itimileno caqi paqima hibatequa enetemaqua hochie chisonimichumasta monimano mucuyaha, iposta hica narutuquata paqima hibasomibiletequa nastama. Acu itimile noyoquamano mucu yuchaqua iposta caqui nochiqe naiquentequa ininomimaqua na maha habechule. Naqueniqe hiti pahama tahachinara mitela naquentemano norobista naquenta calubotele honiquenihabeti maninoleta habema nanela.

THE LORD'S PRAYER.

In one of Pareja's volumes I found a loose sheet of paper, on which a Mexican had, on February 7, 1864, carefully transcribed the Lord's Prayer from the following volume: "Explicacion de la 'Doctrina' que compusó el Cardenal Belarmino por mandado del Señor Papa Clemente VIII. Traduida en lengua Floridana por el Padre Fr. Gregorio de Muoilla, etc., etc., Mexico, 1635."

Heca itimile, numa hibantema;
visamilenema aboquano-lctahauema;
valunu nanemima nohobonihaue;
mine manintaqe numama isota monimaqui caqua utimate;
naquimohaue equela-reqe hono henonica equelete nohobonihaue;
nina ehebotema natequeniqe nimani sibonihaue hecate naquimosima nina ehesibotema natequeniqe manista nicala cume hioninomate;
nini boha manta nihaui, batiqua ninihaue, acu nate isticolete inemiqua nibalubo nihaue. Amen Jesus.

WORDS AND SENTENCES.

acuhiba moon, month.
ahono young; ahono nia girl, daughter.
amita younger brother, younger sister, younger cousin, (used by males only).
apahola buzzard, crow.
chale new, fresh, recent; pure.
chu black, taca chu charcoal (lit. black fire); ano chuca a negro.
-co is the suffixed particle of the objective case. Sometimes it is suffixed to several words of the same sentence. It is variously written ca, co, cu.
eyo other, another.
  ano eyo somebody else; some other person; a neighbor.
ene, ine to see, to look at; ena cho did you see?
  na eneno a sight.
hebuata law, precept, dogma; Diosi hebuata the law of God.
hibua to stay, remain; to be.
  numa hebuantema (for: numama hebuante) dwelling in heaven; yaqua hibuabila aquita she remained a virgin.
hio to mock, scoff; to curse, utter maledictions; istico hiote cho? didst thou say evil?
hiti 1) demon; 2) Devil of the Christian religion; hiti-paba, or, hiti-hica-taca hell, lit.: "Devil's house"; "Devil's land's-fire."
holaqiti, span. gacha: a sort of fritters, or hasty-pudding; probably made of Indian corn (holaba).
hubua, hubasote, hubuasota to love, worship, reverence.

ichali weir (in the coast dialect; puyu, jufere in the dialects of the interior districts).

ilaqe night; ilaqema at night.

inti is the negative particle "not" (-ti) before imperatives.

iqila sick, diseased.

iqilabo sickness, disease, malady.

iqilabosobi cho? did you become sick?

iquini breast, udder; milk.

iquinena my deceased mother.

iquiti to insult, abuse.

isti bad, wrong; ni hiotala istico I say evil (of somebody).

yame brother-in-law.

yamemitama sister-in-law (used by men only).

yaqua she.

yuru to tremble; to fear, to be afraid; to be angry.

moca sea, ocean; moca mine great sea; maca pira Red Sea; mocamelo salt sea.

mucu eye; mucubine tears (for: mucu-ibine, eye-water); mucu yucha two eyes; mucu yuchaqua both eyes.

nahe, nae to possess, to have: itimi chi nahe hast thou a father?

nohoba, nohobua, nohohaue to give, to bestow, to present with. Often ohohaue, hohaue (by aphæresis).

naquen, nakoso thus, so, in this manner; naquenela it is so.

nanacu because.

niye, nie herb.

numa heaven, sky; numama in heaven.

oyo inside, within; Iglesia oyoma within the church; oqúo oyo intestines (lit. "inside the body").

paha house; pahama into the house.

hiti-paha hell.

ticopaha ship (lit. "canoe-house").

piro, pira red; ano pira Indian: maca pira Red Sea.

putuo to detest, loathe, hate; anoco putuobobi cho? did you loathe anybody?

-reqe, distributive particle; viroreque each man; chuquareqe? how many times each? equelareqe daily, day for day.

paqi island; caqi pahima upon that island.

-ti, -ti-, -te, the negative particle *not*, suffixed to or inserted into words: f. i.: ni Christianotila I am not a Christian.

tinibo 1) to pierce, perforate, transfix. 2) woodpecker.

ufueta pimp.

uquo, oquo 1) flesh, meat; 2) to eat, to feed on (said of maize, meat, f. i.); 3) body, person; oqúo oyo entrails, bowels; 4) infant; uquo viro a male infant.

Descriptions of Extinct Batrachia and Reptilia from the Permian formation of Texas.

By E. D. Cope.

(*Read before the American Philosophical Society, April* 5, 1878.)

REPTILIA.

DIADECTES SIDEROPELICUS. Gen. et. sp. nov.

Char. Gen. Teeth with short and much compressed crowns, whose long axis is transverse to that of the jaws. Edges of the crowns obtuse, with tuberosities on some of them, distinct from the principal apex. The latter is worn off very obliquely by attrition in all of the specimens. The crowns covered with an enamel-like substance which has no especial sculpture. Alveoli not separated. The external alveolar border in each jaw is more elevated than the internal, and in the superior series at least, diverges from the tooth-line backwards and outwards. The surface of attrition descends outwards in the maxillary series, and rises inwards in the dentary series. A large fossa pierces the inner alveolar border just behind the inner extremity of each tooth.

The affinities of this very singular form cannot yet be determined. The mandibular ramus rises directly from the posterior extremity of the dental series, showing that there is a coronoid elevation of the dentary bone as in *Dinosauria.* The teeth are received into deep alveoli. It is probable that the vertebræ are amphicœlous. The animals belonging to this genus were, in all probability, herbivorous.

Char. Specif. The jaws, and probably other bones of three individuals of this species, represent it in my collection. The lateral tuberosity of the teeth already described is on the most elevated, hence opposite, borders of the crowns in the two jaws. It differs in its degree of prominence in different teeth, but is subject to attrition in one of the jaws at least. The form of the principal worn surface is an elongate oval. The investing layer of the crown is perfectly smooth, excepting between the lesser and greater cusps, where the obtuse edge is slightly longitudinally grooved. The surface of the jaws is not sculptured.

Measurements.		M.
Greatest elevation of a tooth (No. 1)		.011
Diameters of crown	transverse	.006
	antero-posterior	.012
Four teeth occupy		.042
Four alveoli of No. 2, occupy		.024

The jaws are as large as those of a medium-sized alligator.

DIADECTES LATIBUCCATUS. Sp. nov.

The anterior portion of a probably maxillary bone represents this species. On comparison with the corresponding portion of the jaw of *D. side-*

ropelicus, the following characteristic marks appear: The tooth-line diverges much more strongly inwards from the maxillary border in the *D. latibuccatus*, leaving a wide groove between the two. This groove is separated by a narrow horizontal partition from a corresponding one of the superior face of the same element, and its surface is longitudinally roughened. The teeth are closely placed, and the series turns with the anterior extremity of the jaw, abruptly inwards. The transverse diameter of the teeth lessens to just posterior to the point of curvature, so that their section is nearly round; at and anterior to the curve, the wide transverse diameter is resumed, the last alveolus preserved making an angle of 45° with those in the posterior part of the jaw. The external surface of the maxillary bone is roughened, as is also the case in the *D. sideropelicus*, with coarser and finer irregular impressions, fossæ and grooves.

Measurements.	M.
Width of jaw at ninth tooth from curve	.036
Width of ninth tooth from curve	.011
" " fourth " " "	.006
" " tooth at curve	.008
" " third tooth anterior to curve	.010
" " jaw at curve	.019
Elevation of alveolar part of jaw	.018
Three teeth in	.015

There are other fragments of jaws referable to *Diadectes* whose specific reference is uncertain.

BOLOSAURUS STRIATUS. Gen. et. sp. nov.

Char. Gen. Teeth fixed in shallow alveoli, and with the crowns expanded transversely to the axis of the jaws. The crowns swollen at the base, and with low apex, divided vertically into two equal portions. The postero-internal half in the maxillary series is low and horizontal; the antero-external portion forms a curved cusp, which has a semicircular section. The teeth of the lower jaw are similar, but the relative positions of the ledge and cusp are reversed. Anterior teeth of superior series composed of external cusp and internal ledge. No enlarged canine or incisor teeth. Bones of face not sculptured.

This genus is represented by a good many remains, which include some partially complete crania. These show that there is no quadratojugal arch, and that the quadrate is of the flat character of that of the *Anomodontia*, and was probably immovable. The orbit is complete behind, and there is a strong squamosal arch. The vertebræ are amphicoelous, and probably notochordal. The neural arches are freely articulated with the centrum, and the zygapophyses and neural spine are well developed.

The vertebræ resemble those of *Lysorophus*[*] (Cope) from the Illinois Permian, but they do not display the deep longitudinal fossæ of that genus.

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[*] Proceed. Amer. Philos. Soc. 1877, p. 187.

Char. Specif. The external surface of the crown is marked to the apex with waved grooves of the enamel. The edge of the elevated cusp, which presents posteriorly in the maxillary teeth, constitutes the abrupt termination of the exterior face, and is serrate by the interference of the sulci. The edge of the basal ledge is slightly serrate. The muzzle is rather elongate, and the sides of the maxillary and dentary bones are plane and smooth. The mandible is rather narrow, and forms a narrow wedge in profile outline. It rises posteriorly behind the dental line. The teeth are separated by intervals as wide as a tooth.

Measurements.	M.
Long diameter of orbit No. 1	.0130
Depth of upper jaw at orbit	.0045
“ lower jaw at front of orbit	.0050
Four teeth in	.0080
Elevation of a crown	.0025
Transverse diameter of inferior molar No. 2	0025

From the same locality as the *Diadectes sideropelicus.*

A slight modification of character is found in two imperfect crania. The principal character is to be seen in the teeth. The enamel of the external surface of the cusp is not sulcate, but is smooth ; and the posterior cutting edge of the cusp is much less distinct. It is, in fact, obtuse, and not serrate. The orbit is large, and the front and muzzle are regularly decurved to the premaxillary border. The angle of the mandible is moderately prominent, and is massive and obtusely truncate. The interorbital region is flat in the transverse direction.

Measurements.	M.
Length of skull to mandibular angle	.050
“ “ orbit	.015
Long diameter of orbit	.018
Width of interorbital region	.009
Six teeth in	010

BOLOSAURUS RAPIDENS. Sp. nov.

Established primarily on a tooth from the posterior or middle portion of the series, with which is associated another, probably from an anterior position in the jaw. The size is many times greater than that of the species of this genus already described, and it is uncertain whether the posterior tooth possesses the internal ledge characteristic of them. The anterior tooth does not possess it. The transverse diameter of the crown is considerably greater than the antero-posterior, and the convexity of the outer side is without facets. One side of the curve is flatter than the other. The enamel is perfectly smooth. The inner face is occupied by the surface of attrition of the corresponding tooth of the opposite jaw. The supposed anterior tooth is from another locality. Its section is similar to that of the present tooth, and the enamel is similarly smooth. The cutting edges are both smooth, and bounded by a little groove next the plane inner face. The crown is much more elevated than that of the tooth first described, and is in general shaped like a claw. It may be from the pterygoid bone of another genus.

Measurements.		M.
Elevation of crown (axial)		.010
Diameter of crown	antero-posterior	.006
	transverse	.008

ParioticHUS BRACHYOPS. Gen. et. sp. nov.

Char. Gen. This form is represented by a cranium which has lost its superficial osseous stratum at some points, and the entire occipital region. The temporal fossæ were covered by a roof continuous with the postorbital region; the zygomatic arch extends low down, producing a resemblance to certain tortoises. The orbits are small and lateral, and the muzzle is short, with terminal nares. Their exact character cannot be ascertained. The teeth are rooted, and have compressed obtuse crowns, with cutting edge; they diminish in length posteriorly, and do not display any elongate canine. The cranial bones do not exhibit any sculpture.

This genus is quite distinct from the others here described from corresponding parts of the skeleton. In the constitution of the skull it resembles Prof. Owen's genus *Kisticephalus* from supposed Triassic beds of South Africa, but differs totally in dentition.

Char. Specif. The interorbital width is twice the diameter of an orbit, and is nearly flat. The cheeks behind the orbits are swollen; the canthus rostralis is obtuse. The muzzle is obtuse, broadly rounded, and somewhat depressed; the nostrils were not large. The orbits are subround, and measure one half of the length of the muzzle measured axially above. The mandibular rami are not deep. The longest teeth are below and in front of the anterior border of the orbit; posterior to this point they diminish rapidly, and are reduced to a very small size. The crowns of the greater number of the teeth are short and much compressed, and the enamel is coarsely longitudinally grooved. An anterior mandibular tooth has a subconic crown.

Measurements.	M.
Width of skull at parietal region	.020
Length " from "	.022
Interorbital width	.010
Four teeth in	.004
Length of root and crown of a tooth	.002

From the locality of the last species.

ECTOCYNODON ORDINATUS. Gen. et sp. nov.

Char. Gen. Cranium short and wide, with large post-frontal bones and a large orbit. Cranial bones sculptured, but no lyra. Teeth rhizodont, with elongate compressed crowns with anterior and posterior cutting edges. One of these between the orbit and nostril larger and longer than the others, and lying outside of the closed dentary bone. Mandibular symphysis not sutural, but ligamentous. Terminal mandibular tooth not small. Teeth not faceted, simple.

This genus, which I suppose to be reptilian, is represented by a specimen which lacks the posterior portion of the skull; hence its near affinities cannot be determined. In the character of the cranial sculpture it resembles crocodiles, and the Labyrinthodont genera cotemporary with it, and differs from *Lacertilia* with cranial sculpture known to me.

Char. Specif. Parietal and frontal regions flat, the latter joined to the maxillary by a rectangular canthus. Interorbital region wide, equal to the diameter of the orbit. Sculpture of vertex in longitudinal series of pits of considerable irregularity. There are ten or twelve such rows between the orbits. The crowns of the teeth are obtuse, and their surface smooth.

Measurements.	M.
Interorbital width of skull	.009
Width between prefrontal borders	.014
Depth of facial plate of maxillary	.007
" ramus mandibuli at orbit	.006
" " " near end	.003
Length of short maxillary tooth	.0015
" long " "	.0030
Width " " "	.0015

The skull of this species is about as large as that of the *Heloderma suspectum.*

CLEPSYDROPS NATALIS. Sp. nov.

This reptile is represented by numerous portions of the skeleton, including a cranium, and thus offers the best basis of information as to the character of the genus *Clepsydrops* which has yet come into our hands. This furnishes numerous interesting characters, which as found in a single individual furnish a basis of estimation for the entire group.

Char. Gen., et cœtera. There is no quadratojugal arch, but the zygomatic and postorbital arches are present. The squamosal extremity of the zygomatic arch descends low on the quadrate as in turtles, preventing mobility of the latter. The quadrate is not prominent in the specimen, and appears to have been a thin bone, as in *Ectocynodon.* The nostril is large and latero-anterior; The symphysis of the mandible is short, and the premaxillary bones appear to be distinct; they are separated in the specimen by displacement, with the indication that the junction was sutural. The teeth were of different sizes, and the premaxillaries and canines are distinguished from the others by their proportions. All are sub-round in section, with more or less defined anterior and posterior cutting edges. The premaxillary teeth are larger anteriorly, diminish posteriorly, and are separated by a notched diastema from the large canine. The succeeding teeth are of medium proportions. The roots are sunk in deep alveoli. There is no surface sculpture of the cranial bones, which is the character distinguishing the genus *Ectocynodon* from *Clepsydrops.*

The vertebræ have been described elsewhere, but important additions to our knowledge can now be made. There are mostly small intercentra throughout the dorsal and caudal series, in the latter prolonged into two processes below, constituting chevron bones. The transverse processes on the dorsal and lumbar vertebræ are undivided, and on some of the dorsals, the ribs articulate with the centrum as well. They are present on the anterior but wanting on the posterior caudal vertebræ. In adults the neural arch is coössified with the centrum, and on the lumbar and sacral region the neural spines are greatly elevated, indicating the presence of a fin like that of *Basiliscus*. In one of the allied species the diapophyses of three vertebræ are vertically expanded for the attachment of the ilium, but the centra are not coössified.

The humerus in this genus is of remarkable character. Its proximal extremity is expanded and regularly convex, with the articular surface at right angles to the sides of the bone, and not developing a head. There is a strong deltoid ridge or tuberosity, not extending far from the head. The shaft is much contracted, and the distal end is more expanded than the proximal. It is flattened, and supports no condyle. Its outline is transverse at the middle and truncate at each lateral extremity. A large supracondylar foramen pierces the basal part of the distal expansion near the inner border. The opposite edge is strongly grooved longitudinally, the groove being bounded in front by a prominent crest, which sinks just proximad of the distal border.

The ilium is a flat bone which contracts downwards and forwards to the pubis. The latter is something like the ilium in form, widening in the opposite direction, *i. e.* downwards and forwards. Its form is something like that of the *Crocodilia*, and it is uncertain whether those of opposite sides unite below. The ischium is a remarkable bone. It is greatly produced anteriorly and posteriorly to the acetabulum, in forming with that of the opposite side, a keeled boat-shaped body, which at its superior middle portion includes the inferior part of the acetabulum. In *C. natalis*, the anterior apex is below the middle line of the pubes near their anterior border. In the same species there is an additional small element between the ilium and pubis on the superior side at their junction. The acetabulum is formed by the interrupted junction of the three elements.

The femur possesses no third trochanter, and the head and great trochanter are not separated by a neck. The little trochanter is large, and the condyles are well defined. The head of the tibia is expanded, and the fibula is well developed at both extremities. The phalanges are moderately elongate, and are depressed. The claws are curved and compressed below.

The various remains of this genus now in my possession, and especially the skeleton of *C. natalis*, show that the determinations of various parts of the skeleton made from isolated fragments from Illinois, were correct.

Of the general affinities of this genus it is only necessary now to state that my reference of it to the *Rhynchocephalia* is confirmed. It differs from the recent species of the order in the absence of quadrato-jugal arch, and the remarkably developed ischia. On this account I refer to *Clepsydrops* and its allies as a distinct suborder under the name of *Pelycosauria*.

Char. Specif. The muzzle of this species is compressed and descends obtusely at the end as in *Bolosaurus striatus*. The nostril and orbit are quite large. The first premaxillary tooth is the largest and has a silky striation of the enamel; its crown is much less than that of the canine. The canine originates below a point a short distance posterior to the nostril.

Measurements.	M.
Length of skull to posterior base of quadrate..........	0.124
Diameter of nostril....................................	.019
Depth of zygoma at orbit............................	.012
Length of crown of canine tooth....................	.016
Antero-posterior diameter of canine tooth.............	.005

The centra of the lumbar vertebræ are compressed, but not deeper than long, nor acute on the median line below. The diapophyses are wide, and descend towards the anterior articular border. The neural spines are compressed, and are very long. Their apices are slender and curved backwards. The faces of the zygapophyses are oblique upwards and outwards. The caudal vertebræ have subround articular extremities anteriorly, and become more compressed posteriorly. The diapophyses are median on the former, and gradually become smaller to extinction. The zygapophyses are strong, and the neural spines continue long for a considerable part of the length of the entire series. The centrum is concave below the diapophyses, and has a median inferior rib.

Measurements.	M.
Length of centrum of fourth from last lumbar vertebræ.	.018
Vertical diameter of " " "	.017
Transverse diameter of " " "	.018
Elevation of neural arch and spine of last lumbar......	.087
Antero-posterior extent of ilium........................	.059
" " " " pubis.................	.060
" " " " ischium..............	.143
Depth of pelvis...	.080
Length of femur...	.120
Long diameter of proximal end........................	.041
Length of tibia...	.085
Transverse width of tibia...............................	.029
Length of eleven caudal vertebræ.....................	.172
" " fourth caudal "	.016
" " eleventh caudal "	.014
Transverse diameter of caudal.........................	.012

This species differs from the *C. vinslovii* in the more robust caudal vertebræ. It is also considerably larger, agreeing in this respect with the *C. pedunculatus*. In the latter the long transverse processes are decurved and narrowed at the extremities in a manner not seen in any of the known vertebræ of *C. natalis.*

DIMETRODON INCISIVUS. Gen. et sp. nov.

Char. Gen. Dentition as in *Clepsydrops* in the superior series. Pubic bone not distinct from ischium. Humerus with trochlear condyles and a defined proximal articular surface.

The genus *Dimetrodon* embraces larger forms than the known species of *Clepsydrops.* It is probable that the species had the neural spines in the lumbar and dorsal regions elevated in the same way. The humerus, while of the same general character as that of *Clepsydrops,* differs remarkably in its more perfect articular surfaces, indicating a terrestrial habit as distinguished from a probably aquatic one in the former genus. The supracondylar foramen is present in this genus, and the proximal articular surface winds obliquely round the expanded extremity of the bone.

The separate jaws of *D. incisivus* show well the character of the dental insertions. A strong thickening of the inner wall of the maxillary bone is all that represents the palatine lamina. This enlargement does not extend to the level of the external alveolar margin, which thus forms a parapet. The roots of the teeth are long, and are contained in deep alveoli of the palatine thickening; but the portion of them which projects beyond the alveoli is adherent to the external parapet by the side, and hence the teeth appear to be pleurodont. They are shed in after the absorption of the root in consequence of the presence of the crown of the successional tooth. The process commences at the inner alveolar border, and extends inwards and upwards, invading the palatine wall of the maxillary bone.

Dimetrodon is allied to *Deuterosaurus* Eichw. and *Eurosaurus* Fisch. as defined by Meyer, the former known from a portion of the cranium, the latter from bones of the skeleton. From the former it differs in the persistence of the sutures separating the elements of the jaws, supposing the figure reproduced by Owen (Quar. Journ. Geol. Society, 1876, p. 358) to be correct in the omission of them. Apart from this, *Deuterosaurus* has much more elevated nostrils, more numerous incisor teeth, and wants the extensive diastema in front of the superior canine. *Lycosaurus* Ow. from the South African Trias resembles it much more nearly, but does not present the greatly enlarged anterior incisor teeth of *Dimetrodon.*

Char. Specif. This saurian is established on the nearly complete premaxillary and maxillary bones of the right side with the left maxillary of the same individual. Associated with these are portions of the post-frontal, frontal and nasal bones of the right side of perhaps the same individual, but as the pieces are loose, this relation cannot be positively affirmed. Portions of the maxillary, premaxillary and other bones, with isolated teeth of numerous other individuals are in my possession.

The first named specimens show that the mutual premaxillary and premaxillo maxillary sutures are distinct. There is a deep emargination of the border of the jaw at the latter suture, and the maxillary alveolar borders is gently convex downwards. The nostril is large, and is directed forwards as well as outwards: the premaxillary spines are narrow. The form of the muzzle and jaws when in normal relation was vertical and compressed front. The premaxillary border of the jaw is rounded and contracted behind the nostril; the outline then expands backwards. There are but two incisor teeth, of which the anterior is much larger than the second. Its root is irregular in section owing to the presence of one or more shallow longitudinal grooves. The pulp cavity of some of the larger teeth is much contracted opposite these grooves by the corresponding internal face, which is disproportionately convex. The anterior two teeth of the maxillary bone are larger than those that follow, the anterior exceeding even the first incisor. The other maxillaries are smaller and sub-equal, excepting the last two, which are the smallest. The crowns of the teeth are lenticular in transverse section, the external side being much more convex than the internal. The cutting edges are defined from the convexity of the latter by a shallow groove at the base of each. The edge is not crenate as in *Lælaps* and allied genera, but presents much the same appearance owing to the presence of a transverse corrugation. There are fourteen teeth and empty alveoli in the maxillary bone.

Measurements.	M.
Length of premaxillary axially, to middle of maxillary suture	.040
Length of maxillary bone on alveolar edge from middle of premax. suture	.230
Greatest width of premaxillary	.036
Depth of face of premaxillary bone at nostril	.030
Length of diastema (chord)	.032
Depth of maxillary at third tooth	.110
" " antepenultimate tooth	.066
Diameter of base of crown of first incisor tooth	.015
" first maxillary tooth	.018
" fourth " "	.009

The portion of cranium above mentioned displays a number of peculiarities. The orbit is lateral, and has a prominent and convex superciliary border. The zygomatic arch is so curved upwards as to complete the orbit behind by the intervention of a postorbital or postfrontal bone, which separates the malar and squamosal bones from mutual contact. In front of this bone a portion of the frontal forms the superciliary border, and in front of this, the prefrontal sends a wide process behind the lachrymal to the orbit. This bone resembles a nasal bone in form, and extends forwards, and is decurved at the extremity. The width of the descending or malar process of the postfrontal is such as to partially separate the orbit from the zygomatic fossa. The superciliary surface is swollen, and is interrupted by a transverse groove on the orbital part of the prefrontal. There is a vertical open groove on the malar process of the postfrontal.

Several large pelvic bones corresponding with those which I have called ischia in *Clepsydrops natalis*, are of a size appropriate to the present species. They include both the ilia, ischia and pubes in one mass, forming a compressed boat-shaped body with a prominent inferior keel.

The prominent character which distinguishes this species is the shortness of the ischiatic symphysis. Its extent anterior to the acetabulum is only one-half the diameter of the latter, while it equals that diameter in the *C. gigas*. It follows from this, that the crest arising from the anterior border of the acetabulum is abruptly decurved a little anterior to the latter, and descends to the inferior keel at a very steep angle. At its point of decurvature is a prominent tuberosity. The front of the symphysis pubis presents an obtuse keel, which terminates short of the apex. The inferior border of the acetabulum is not sharply defined, except at its posterior portion.

Measurements.	M.
Total length	.260
Length from posterior border of acetabulum forwards	.148
Long diameter of acetabulum	.095
Total vertical diameter to superior border of acetabulum	.135
Length of anterior symphysis	.085

From the same locality as the last species.

DIMETRODON RECTIFORMIS Sp nov.

This species is represented by portions of the vertebral columns of three individuals at least. Its size exceeds considerably that of the *Clepsydrops natalis*, equaling that of the *C.* (*? Embolophorus*) *limbatus* Cope. Of the latter species I possess numerous vertebræ, and they all differ in a marked manner from the present species.

In *Dimetrodon rectiformis*, the depth of the centra does not exceed the length. The margins of the articular faces are not twisted, and the articular faces of the zygapophyses are horizontal. The opposite is the case in the *C. limbatus*. The spaces for the intercentra are small; they are large in *C. limbatus*. The vertebra described as typical is a posterior dorsal. Here the diapophyses is nearly sessile, and below the line connecting the zygapophyses. Its costal articular surface is narrowed downwards and forwards, almost reaching the recurved border of the anterior face. The neural spine is much elevated, and the sides of the centrum are concave. The inferior articular borders are connected by an acute nearly horizontal edged keel.

Measurements.		M.
Diameter of centrum	antero-posterior	.031
	transverse	.034
	vertical	.026
Expanse of posterior zygapophyses		.030
Length of base of neural spine		.025

From the same region as the other species here described.

DIMETRODON GIGAS. Sp. nov.

Clepsydrops gigas. American Naturalist, May, 1878, p. 327.

This animal is only represented in my collection so far by a large part of the pelvis. This is of the same character as that of the *C. natalis*, but differs in several details of form and is three times as large in linear measurements. The portion anterior to the acetabulum is shorter than in the *C. natalis*, and relatively deeper. The raised borders of the acetabulum unite, and form a thick obtuse horizontal crest, which continues to the apex, which consists of a broadly expanded shovel-like projection. This symphyseal portion is quite elongate, and carries on its supero-anterior face an obtuse median keel. The opposed elements diverge above the anterior part of the acetabulum. The latter is shallow but entire; its most prominent borders are the anterior and postero-inferior.

Measurements.	M.
Length from posterior border of acetabulum forwards...	.200
Long diameter of acetabulum	.100
Total vertical diameter to superior border of acetabulum	.155
Length of anterior symphysis	.175

EPICORDYLUS ERYTHROLITICUS. Gen. et sp. nov.

Char. Gen. *Epicordylus* is known from a large part of the vertebral column, including all the regions excepting the cervical, so far as at present appears. In general the vertebræ resemble those of *Clepsydrops*, having well-developed intercentra. The diapophyses are at the base of the neural arch, and are prominent, and with large undivided articular extremity; they are not present on the caudal vertebræ. The neural spines are compressed below and enlarged transversely above, so as to be claviform. They are not elongated over the lumbar or sacral regions, but are similar to those of the dorsal vertebræ at those points. The *ossa ilii* resemble those of *Clepsydrops*. The zygapophyses are as usual oblique upwards and outwards, and the centra are not shortened.

Char. Specif. The centra are a little compressed, and higher than wide. In the anterior caudal region they are a good deal more compressed. The intercentra in a part of the dorsal series are larger than in any known species of *Clepsydrops*. The neural spines are bilobed at the apex on the sacral region, and become shortly bifurcate on the caudal series.

Measurments.	M.
Length of a series of seventeen dorsal vertebræ.........	.610
" an anterior neural spine....................	.050
" posterior..................................	.070
" tubercular costal face of anterior dorsal.....	.020
" " " on seventh vertebræ of the series from the last..................	.035
" five caudal vertebræ of probably the same animal.................................	.180
Elevation of fourth caudal neural spine................	.057

Width of neural spine at summit	.035
Length of ilium	.120

This species appears to have been about the size of the Mississippi alligator. Unfortunately the cranium is unknown, but probably some of the jaws and teeth in my possession belong to it.

From the region above already mentioned.

METARMOSARUUS FOSSATUS. Gen. et sp. nov.

Char. Gen. There are numerous vertebræ in the collection, from the median and anterior dorsal parts of the column, which differ from those of *Clepsydrops* and *Epicordylus* in their small antero posterior diameter. That these all belong to one species, or even one genus, is not probable, in view of the many differences which they present. I select one of them whose characters are most strongly marked, and designate it as above, without deciding, as yet, how many of the others which agree with it in some respects, may hereafter be associated with it as to species or genus.

The centrum is a good deal shorter than wide, and like those of all the other genera here described, is deeply biconcave. I have not yet ascertained whether it is notochordal, owing to the state of the specimens. The diapophyses project just below the base of the neural arch, and are short and with small tubercular facet. There is no capitular facet. The facet for the intercentrum is excavated at the anterior extremity of the base of the centrum and is quite small. The neural canal is rather large. The anterior zygapophyses have a peculiar form, their articular faces being directed downwards and outwards. This character, together with the form of the centrum and intercentrum, distinguishes this genus at once from those previously described.

Char. Specif. The posterior articular face is a little deeper than wide, and has rather thick recurved margins. The sides are concave, and the middle line below protuberant (in section), but not keeled. The intercentral fossa is a transversely oval pit well defined all round, and not interrupting the contour of the inferior margins of the articular faces.

Measurements.		M.
Diameter of centrum	antero-posterior	.021
	transverse behind	.030
	vertical "	.030
	" in front	.024
Width of intercentral fossa		.010
Expanse of posterior zygapophyses		.025

About the size of the *Dimetrodon rectiformis*.

EMPEDOCLES ALATUS. Gen. et sp. nov.

Char. Gen. This genus is of the same type as those already described as allied to *Clepsydrops*. I know of it from numerous vertebræ, but few of which belong to any one individual, four consecutive centra being the largest number I have obtained in association. The various specimens described, belong to the cervical and dorsal regions, and it is not unlikely that one series which is not yet extricated from the matrix, includes also lumbars, sacrals and caudals. But of the latter I am not at present able to give any account.

Both dorsal and cervical vertebræ possess centra of the general character of those of *Clepsydrops*, with small intercentra. The neural arches present important differences. There is on the posterior aspect, below the zygapophyses a well developed hyposphen, and on the anterior face a correspondingly strong hypantrum. The structure is identical with that which I have described as present in the genera *Camarasaurus* and *Amphicœlius*, but is rather better developed. It disappears at some posterior point of the dorsal series. The zygapophyses are much elevated and spread apart in *Empedocles*, and are connected together back to back. From this junction the diapophysis depends, forming a vertical septum whose inferior extent is greatest on the cervical, and least on the dorsal vertebræ. It is undivided, and as there is no capitular facet on the centrum, the rib had but a single head. The expansion of the diapophyses with that of the posterior zygapophyses gives to the posterior side of the vertebra a remarkable appearance, and forms an oblique roof above the centrum. The neural spine is not elevated, and is very robust, being in some cases greater in the transverse than the antero-posterior diameter, again approximating remotely *Camarasaurus*. Of the dentition nothing is known, but some jaws with teeth of animals allied to *Clepsydrops* may belong here. Probably other portions of the skeleton are in my possession, but I am unable as yet to correlate them.

Char. Specif. The diapophyses are not long, and their articular surfaces are quite elongate downwards and forwards, especially on the cervical centra. On more posterior dorsals the diapophysis arises exclusively from the neural arch, but maintains its very narrow oblique articular face. On all the vertebræ the centrum is about as long as wide, with regular marginal angles without bevel for intercentrum. The sides are concave, and the inferior median line horizontal, and thickened. The neural spine is short in the dorsals, and with a subquadrate section, with the angles lateral and antero-posterior. The apex is excavated at the extremity. The space between the planes of the opposite zygapophyses is strongly convex. The latter have horizontal faces. In other vertebræ the neural spine is more transverse, and the zygapophyses are separated on the median line by a smaller fossa on the anterior face of the arch, and a larger one on the posterior face.

In a specimen in which the hyposphen has disappeared, it is represented by a ridge connecting the posterior zygapophyses, which is decurved over the neural canal.

Measurements.	M.
No. 1, dorsal vertebra of smaller individual.	
Total elevation of vertebra	.105
Elevation of centrum	.029
" " zygapophyses	.060

Measurements.		M.
Elevation of base of neural spine		.083
Width of apex " " "		.025
Vertical extent of extremity of diapophysis		.036
Diameter of centrum	antero-posterior	.026
	transverse	.027
Width between inferior extremities of tubercular facets of diapophyses		.066
Width between extremities of zygapophyses		.082
Length " " " "		.042
No. 2, a larger individual.		
Total elevation		.130
Diameter of centrum	antero-posterior	.029
	transverse	.043
	vertical	.039
Extent of zygapophyses		.102
Elevation of neural spine		.026

The portions of the vertebral columns referred to this species cannot be reconciled with those of any of the species of *Epicordylus* or *Clepsydrops*. In both of these, large parts of the dorsal series are known, and even if those genera should possess dorsal vertebræ with hyposphen, which is very improbable, the peculiar forms of the zygapophyses and neural spine will still distinguish them widely.

EMBOLOPHORUS FRITILLUS. Gen. et sp. nov.

This form reposes on some dorsal vertebræ with intercentra and ribs in place, which display some interesting characters. The neural arch is coössified, and the zygapophyses and diapophyses are well developed; the latter not elongate, and standing on the base of the neural arch. The centra are notochordal. The intercentra are narrowed and transversely extended. The ribs are two-headed; the capitulum is received into a fossa of the posterior border of the intercentrum in advance of the vertebra which supports the diapophysis, to which the tuberculum is attached.

The curious mode of articulation of the ribs I have not observed in the species of the genera heretofore described, unless the forms of some of the intercentra of the *Clepsydrops limbatus* indicate it. If so, that species must be removed to *Embolophorus*.

Char. Specif. Centra with a circular section at all points, and contracted at the middle. No carinæ or grooves. The intercentra project beyond the edges of the centra, giving the column the appearance of supporting annular ridges. Their lateral angles extend upwards nearly to the base of the neural arch. The diapophyses are short and are directed upwards and forwards; their extremities are concave. The zygapophyses are large and their articular faces nearly horizontal. The size of this species is small, little exceeding that of the *Bolosaurus striatus*.

Measurements.		M.
Length of a centrum with an intercentrum attached		.0056
Length of centrum		.0040
Diameter of centrum	vertical	.0035
	horizontal	.0035
Expanse of diapophyses		.0080
" heads of rib		.0035
Elevation to summit of neural canal		.0045

Comparison with the vertebræ which I have found associated with the jaws and teeth of *Bolosaurus striatus* reveals the following differences: The neural arches of the latter are distinct; the intercentra are not present on the vertebræ observed (five in one series and five in another); and the centra are compressed with inferior rib. There are no capitular articular facets in the vertebræ of *Bolosaurus* described.

THEROPLEURA RETROVERSA. Gen. et spec. nov.

Char. Gen. Rhynchocephalian reptiles with free neural arch, and a capitular costal articulation on the centrum; the intercentrum probably, and the hyposphen certainly, wanting.

This genus is similar to *Lysorophus* in its free neural arch, but there is no capitular costal articulation on the known vertebræ of that genus. The small costal face of the diapophyses is distinct from what is seen in *Epicordylus* and *Empedocles*.

Char. Specif. Size medium, or rather larger than that of *Clepsydrops natalis*. A number of small vertebræ may belong to a young individual, but I regard as type a dorsal vertebra of an adult, where the suture of the neural arch is visible but adherent. The species is characterized by the wide posterior expansion of the border of the articular face of the centrum, forming the capitular facet for the rib. It approaches near to the diapophysis, and descends to the basal fourth of the centrum. There is an angular ridge passing backwards from the inferior border of the diapophysis to the border of the articular face. Below this angle and behind the capitular costal face the centrum is deeply concave, the concavities of the opposite sides being separated below on the median line by a narrow obtuse keel. The centrum is as deep and long as wide.

Measurements.		M.
Diameter of centrum	antero-posterior	.025
	vertical	.025
	transverse	.025

The small specimens agree with the large one in the strong, longitudinal angle connecting the diapophysis with the posterior border of the centrum, and in the wide capitular articular surface.

THEROPLEURA UNIFORMIS. Sp. nov.

This species is represented by the vertebræ of two individuals, and perhaps of two others of smaller size. The dorsal centra are characterized by the absence of lateral and inferior edges, and the narrow reflected portion of the anterior border for the capitular facet. The diapophyses are short and the tubercular surfaces not much extended. The zygapophysial surfaces are but moderately oblique. The sides of the centrum are gently and uniformly concave, and the inferior middle line is obtuse and not prominent.

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* Proceedings Amer. Philos. Soc., 1877, p. 187.

The centra of the smaller specimens alluded to, are a little depressed, and may pertain to another part of the column.

Measurements.		M.
Diameters of centrum	antero-posterior	.021
	transverse	.022
	vertical	.021
Expanse of anterior zygapophyses		.019
Width of neural canal		.009

THEROPLEURA TRIANGULATA.

The centra of the vertebræ of three and probably four individuals represent this reptile. The superior part of these resembles that of the *T. uniformis* in lacking the angle posterior to the diapophysis seen in the *T. retroversa*, and in the small extent of the capitular rib-facet. The inferior part of the centrum differs in the presence of three longitudinal rib-like angles, separated by two latero-inferior shallowly concave faces. The median rib is not very prominent, is obtuse, and concave in profile. The articular faces are relatively rather wider than in the vertebræ described as typical of the two species preceding; but in one vertebra (No. 2) the proportions are nearly the same.

In the second vertebra mentioned the neural arch is entirely preserved. The diapophysis is at its base, and of small size; the vertebra is from not behind the median dorsal region. The neural spine is compressed and elevated, and with narrow, truncate apex. The articular faces of the zygapophyses are nearly horizontal.

Measurements.		M.
Diameters centrum No. 1	antero-posterior	.018
	transverse	.017
	vertical	.016
Diameters centrum No. 2	antero-posterior	.023
	transverse	.024
	vertical	.026
Expanse of anterior zygapophyses		.020
Elevation of neural spine above zygapophyses		.052
Diameter of do. at summit	fore and aft	.016
	transverse	.007

BATRACHIA.

ERYOPS MEGACEPHALUS Cope. Proceed. Amer. Philos. Soc., 1877, p. 188.

To the characters which I have ascribed to the genus *Eryops* as above cited, I now add the following. A series of a few large teeth much exceeding the maxillaries in size within the latter, perhaps on the palatine bone. No row of smaller teeth within the maxillary series, or on the vomer, as in *Mastodonsaurus* and *Capitosaurus*. The choanæ are large, and extend well forwards.

This species is the most abundant as well as the largest Batrachian of the formation. Some of the crania are .500 Ms. in length.

It may be added that the vertebræ which I described (l. c.) under the head of this species, and which were found with the cranium which represents it, may not really belong to it.

PARIOXYS FERRICOLUS. Gen. et sp. nov.

Char. Genericus. Suborder *Labyrinthodontia.* Head of medium proportions, with orbits near the middle of the length, and lateral external nares. Epiotic bones prominent, bounding a deep auditory notch. Mandibular angle projecting beyond the glenioid cavity. Maxillary and premaxillary teeth not large, conic, subequal; within them a series of rather numerous teeth, of near the same size, probably rising from the palatine bone. No lyra discoverable.

This genus resembles *Rhinosaurus* and *Eryops*, but belongs to the group with prolonged mandibular angle. Among these it differs from *Mastodonsaurus* and its immediate allies in the deep auditory notch and prominent epiotic bones. From *Labyrinthodon* and *Anthracosaurus*, the uniform sizes of its teeth distinguish it; while there is no indication of the facial fontanelle of *Dasyceps*, which is otherwise much like *Parioxys.*

Char. Specif. This salamander is represented by two crania of similar size, to one of which a few vertebræ are attached. I have not yet removed the matrix enclosing the latter, as it is a task requiring much time. The general form of the skull is a triangle with rounded sides and narrowed and obtuse apex. The parietal region is rather elevated and wide, and is bounded laterally by a low, angular ridge which extends anteriorly from the epiotic angle, diminishing in prominence to the orbit. The external border of the epiotic next the auditory notch is acute, and the posterior angle is decurved, as though it formed the rim of a large *membranum tympani.* Between the epiotic cornua the supraoccipital border is concave The middle of the parietal region is concave.

The orbits are large and have prominent rims, which separate a concave interorbital region, which is less than half as wide as the longest (anteroposterior) diameter of the orbit. The rim is most prominent at the front of the orbit, anterior to which the side of the muzzle is somewhat swollen. There is no canthus rostralis; in its stead there is a concavity behind the nares, with an intervening swelling just behind the latter. These are equally lateral and superior in their presentation. The middle of the muzzle is slightly concave, with a low median longitudinal ridge. If there be any sculpture of the surface of the cranial and mandibular bones, it must be slight; where the thin layer of fine grained matrix which invests it has been removed, it is smooth.

The crowns of the teeth are rather slender; one from the posterior part of the premaxillary bone does not display any cutting edges nor facets. The grooves of inflection are strong, and extend well towards the apex, but they are not numerous.

Measurements.	M.
Length of skull from muzzle to epiotic angle	.100
" " " supraoccipital	.090
" " " front of orbits	.045
" " " nares (axial)	.012
Width of skull at extremities of quadrates	.083
" " between epiotic angles	.035
" " " orbits	.015
" " at front of orbits	.066
" " between nares	.015
Long diameter of orbit	.025

From the same locality and horizon as the last species.

CRICOTUS HETEROCLITUS Cope.

Proceed. Academy Philada., 1875, p. 405. American Naturalist, May, 1878 (published April 22d), p. 319.

Specimens of a number of individuals probably referable to the above species, exhibit many of its characters. These are very remarkable, and indicate another type of vertebral column heretofore unknown.

The intercentra are more largely developed than in any other genus, having the form and proportions of the centra in the caudal region, and being but little smaller in other portions of the column. In the prepelvic region, the true centra only bear neural arches, which are articulated, and bear short diapophyses at their base. On the caudal region they share the neural arches with the intercentra, while the latter bear the continuous chevron bones exclusively. The neural spines are well developed, and not prolonged, in both regions. The ribs are robust, and the abdomen is protected beneath by a series of long, narrow and flat scales, which form imbricated chevrons directed forwards at the middle line.

The phalanges are short and wide, with but slightly condyloid articulations. The distal one is very short, and terminates in a narrowed obtuse projection, somewhat like those of man, but shorter.

A cranium which accompanied the portions of the trunk above described, may belong to the same species. It is that of a Labyrinthodont in some degree allied to *Trematosaurus*. Its form is elongate and the orbits are behind the middle. The mandibles do not exhibit prominent angles, and the epiotic angles are not distinguished by a notch from the posterior border of the os-quadratum. The epiotic bones and two supraoccipitals form the posterior boundary of the table of the cranium; anterior to which the usual parietals and pterotics extend to the frontals and post-frontals. Below the latter is the postorbital, which is bounded behind by the squamosal (supra-squamosal, Owen, Palæontology, p. 176). The quadrato-jugal is possibly distinct from the large malar. There is a "lyra" of two grooves, which are widely separated on the anterior part of the muzzle, and which converge in front of the orbits, which they barely reach. Another groove occupies the inferior margin of the dentary bone. There is a deep auricular fossa beneath the epiotic and posterior part of the pterotic bones. There is but one series of teeth on each maxillary and dentary bone exposed by the present condition of the specimen. The teeth are subequal, gradually increasing in size anteriorly where their long diameters are transverse to the axis of the dentary bone. The surface of the cranial bones is not strongly sculptured. Posteriorly it is rather closely, and anteriorly it is sparsely, punctate. The sculpture of the lower jaw is similar. except that it is smoother posteriorly.

As this species has been already described, further detail is not now given. The present specimens show that the species was founded on a caudal intercentrum, and that the *C. discophorus** was founded on dorsal intercentra. They also show that my original reference of loose phalanges to this genus was correct.

ZATRACHYS SERRATUS. Gen. et sp. nov.

Char. Gen. The existence of this genus is demonstrated by various fragments, the most characteristic of which is a portion of a maxillary bone. This probably belonged to a species of the order *Stegocephali*, but whether to the Ganocephalons or Labyrinthodont division is uncertain, though the evidence is in favor of the former. The teeth are in a single series, and their bases are anchylosed to the bottom of a shallow groove. The external boundary of this groove is more prominent than the internal, so that the attachment of the teeth is shortly pleurodont. The teeth have conic crowns, and have basal grooves indicating the dentinal inflexions common to this group. The maxillary and other bones are characterized by their strong sculpture, in the former the ridges being developed into prominent tubercles in various places.

Char. Specif. The horizontal expansion of the maxillary bone is a character of this species, so that its plane forms an obtuse angle with that of the long axes of the teeth. It presents no palatal lamina. The teeth are separated by intervals of greater width than the diameter of the base. The border of the bone above the teeth is thickened, and the ridges are developed into numerous tubercles. These project externally so as to form a prominent serrate margin entirely overhanging the external alveolar border. The ridges diverge inwards in a radiating manner. The surface is otherwise irregular from the presence of a deep fossa on the outer side within the inner alveolar border.

Measurements.	M.
Length of fragment	.018
Width " "	.018
" " " alveolar groove	.002
Length of prominences beyond alveolar border	.003
Diameter of a tooth basis	.001
Three teeth in	.005

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* Proceed. Amer. Philos. Soc., 1878, p. 186.

TRIMERORHACHIS INSIGNIS. Gen. et sp. nov. Ganocephalorum.

See American Naturalist, May (April 22), 1878, p. 328.

This genus is referred to the *Ganocephala* of Owen, as a Stegocephal Batrachian with vertebral centra represented by separate cortical ossifications, and with the chorda dorsalis persistent in the basioccipital region. The basioccipital bone, although ossified, supports no condyles properly so called, but a cup-like articulation for the first vertebra, like that of fishes, but which is perforate for the chorda dorsalis. It possesses the other characters of the suborder in the presence of zygapophyses and of the quadratojugal arch.

Char. Gen. The centrum is represented by three cortical ossifications of the chorda-sheath, a median inferior, and two lateral. The lateral pieces are quite distinct from each other, and are in contact with the neurapophyses above, and the posterior border of the median segment in front. The neural arch joins chiefly the lateral elements, but is in slight contact with the lateral summits of the inferior element. The halves of the neural arch are coössified, and support well developed zygapophyses, but no neural spine. A lateral expansion of the base of the neurapophyses represents the diapophysis, but it is horizontal and thin.

The cranial bones are sculptured with pits and reticulate ridges. The parasphenoid bone is flat. The external nostrils are large and superior, and not anterior. The angle of the mandible is little produced, and the glenoid cavity is transverse and wider at the inner than the external extremity. The inner wall of the mandible descends from the glenoid fossa, including with the horizontal outer wall, a deep internal pterygoid fossa. No coronoid bone or process. Symphysis short.

The teeth exhibit the inflected dentine of this and allied groups. So far as preserved, they are simply conic, but there are none with the apices complete. There are two series on each side of the upper jaw, both of which consist of larger teeth at their anterior portions. The anterior teeth of the inner row beneath the external nares, are much the largest. A thin bilateral bone from some part of the roof of the mouth supports some large teeth, and a row of small ones diverging from them on each side. The mandibular teeth are in one principal series, and become a little larger anteriorly. Near the symphysis there are on each side, within the external row, one or two large teeth. The ribs are short and little curved, and they have flat expanded heads. They are attached to the diapophysial expansion of the neural arch. Such limb bones as are preserved are without condyles, and are of relatively small size.

Trimerorhachis differs from *Archegosaurus* in the ossification of the basicranial elements; in the absence of attached neural spines, and in the regular and definite tripartite ossification of the chorda-sheath. The form of the cranium of *Trimerorhachis* is unknown.

Char. Specif. There are two large tusks at the anterior extremity of the inner superior row of teeth, and two similar ones on the plate-like element above described. The inferior border of the mandible rises gradually posteriorly to below the posterior border of the glenoid cavity, behind which is a short vertical and compressed angular process, which is rounded in profile. There is a patch of small teeth inside of the posterior extremity of the mandibular series. The mandible closes inside of the posterior part of the quadrato-jugal arch. There is a groove near the inner margin of the inferior face of the mandible ; external to this the surface is marked with elongate shallow pits. The sculpture of the external side of the ramus is less pronounced, and the pits are smallest near the angle. The pits of the top of the cranium are coarse and well defined. The fragment of maxillary bone is broken off four teeth behind the tusks, and the neural opening has contracted but little at that point. The sculpture of the anterior portion of the maxillary is coarsely reticulate.

The diapophyses of the centrum are oblique rhomboids in form, the anterior upper side receiving the neural arch. The external surface is concave and smooth. The median element, which I call the intercentrum,* is a crescent with subacute horns, which terminate below the anterior part of the posterior zygapophyses. The inferior surface is slightly angulate, with two low latero-inferior ridges, and sometimes a low median one. The surface between them is delicately reticulately sculptured. The neural arch is oblique and highest behind. The combined neurapophyses rise rather abruptly behind the anterior zygapophyses with an obtuse and convex margin. They then descend in an arc to the extremities of the posterior zygapophyses, diverging downwards and separated by an open groove which was doubtless the basis of attachment of the cartilage which represented the neural spine. External surface of the neurapophyses smooth. The zygapophyses have little lateral expansion, but are well defined and prominent antero-posteriorly. The processes which I have alluded to above as diapophyses, may not be such, as they are simply transverse expansions of the anterior inferior portion of the neurapophyses, whose posterior border articulates with the lateral diapophyses of the centrum.

The basioccipital condyloid fossa† is transversely hexagonal in outline, the superior border being deeply notched by the superior portion of the *fossa chordæ dorsalis*. The articular surface itself is funnel-shaped. The parasphenoid bone advances far posteriorly under the basioccipital. It expands into an acute angle on each side below the proötic, and then contracts, so that its sphenoid region is narrower than its occipital extremity. Its surface is slightly concave.

Measurements.	M.
Depth of maxillary bone at middle of nares	.021
Width of palatal surface “ “	.014
Six maxillary teeth “ “	014
Diameter of an anterior maxillary tooth	.002
“ “ tusk of inner row	.004
Length of ramus mandibuli to anterior border of internal pterygoid fossa	.058
Depth of do. at do.	.023

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* American Naturalist, May, 1878, p.328

† This term is used as preferable in this case to that of occipital condyle.

Measurements.	M.
Length of ramus mandibuli to posterior border of internal pterygoid fossa	.015
Depth of ramus mandibuli at do	.016
" " " .110 from angle	.016
Six posterior mandibular teeth in	.011
Transverse extent of glenoid cavity	.012
" diameter of condyloid fossa of occiput	.019
Vertical diameter of do	.013
Greatest width of parasphenoid	.034
Thickness of do. at sphenoid portion	.0035
Three vertebræ (measured below) in	.042
Chord of intercentrum	.018
Length of intercentrum below	.010
Thickness " "	.002
Total length of neural arch	.017
Elevation of do. above posterior zygapophyses	.008
Expanse of anterior zygapophyses	.007
Long diameter of lateral diapophysis	.012
Short " " "	.005
Length of a rib	.021
Width of head of do	.008

This species was abundant during the Permian period in Texas, judging from the number of individuals included in my collection.

RHACHITOMUS VALENS. Gen. et sp. nov. Ganocephalorum.

Char. Gen. These are derived exclusively from vertebræ, which appear to belong to only one species. Four is the largest number which has been found consecutively in any one individual, isolated portions of the vertebræ being more abundant. From these, characters of an interesting genus allied to *Trimerorhachis* may be derived.

Each vertebra consists of two segments,—an intercentrum and a neural arch. The true centrum is wanting in the specimens at my disposal, and the intercentrum supports portions of two adjacent neural arches. With these it shares the intervertebral articular face usually borne by the centrum. Each articular face is thus divided into three portions, one third belonging to each neurapophysis, and one third to the intercentrum. Between these the course of the chorda dorsalis is unobstructed. Neural spine present, coössified. Diapophysis large, with a subvertical tubercular costal face. Zygapophyses well developed.

The absence of centrum and presence of neural spine and articular faces on the neurapophyses, with the well-developed diapophyses, distinguish this genus from *Trimerorhachis*. The large intercentra and articular faces of the neural arch distinguish it from *Archegosaurus*.

Char. Specif. The *Rhachitomus valens* is a much larger species than the *Trimerorhachis insignis*, equaling or exceeding the *Empedocles alatus*. The intercentra are very robust; the posterior face is nearly straight, while the inferior border of the anterior face curves backward to meet the former at an angle. The inferior face is convex transversely, and slightly concave antero-posteriorly. The tubercular rib facets are oval, and are narrowed downwards and forwards. The side of the neurapophysis describes a curve which rises a little to the superior part of the extremity of the diapophysis. The zygapophysial surfaces are as wide as long, and a little oblique. The neural spine is not very elevated, and is very robust; its section is a longitudinal oval. Its summit is truncated and thickened laterally.

Measurements.		M.
Diameter of intercentrum	transverse	.035
	antero-posterior	.023
Expanse of diapophyses		.073
Length of tubercular surface of do		.022
Elevation of neural arch		.071
" " spine		.040
Antero-posterior diameter of summit of do		.044

PISCES.

CTENODUS PERIPRION. Sp. nov.

This large species is indicated by a fine palatal tooth of the left side. Its outline approaches that of a right-angled triangle, but the hypothenuse is deeply incised by the interradial notches. The plate is rather thin, and is moderately concave on the inferior face. The ridges number seven, all of which are directed outwards and forwards. They are separated by strong grooves, and have a perfectly smooth and uniform crest, and become more elevated at the distal extremities. The latter are steeply decurved and serrate, both faces being invested with a polished enamel-like layer. This substance is only visible in an edge view, and covers one-half the depth of the margin, being excavated by the extremities of the radiating grooves. The superior face is flat.

The absence of serration from the radiating ridges of this species is a striking feature, allying it to the genus *Ptyonodus*,* where the teeth are wanting.

Measurements.	M.
Length of dental plate	.037
Width " "	.018
Thickness at inner border	.005
" " external border of penultimate crest	.007

From the same locality as the species above described.

CTENODUS PORRECTUS. Sp. nov.

Two teeth of the left palate indicate this species. The tooth is characterized by the small number of its crests (six), of which only one, the very small first, is directed backwards, and the last four are directed forwards. The crests are separated by deep grooves, which terminate in deep emarginations. The anterior crest is produced much beyond the extremity of the penultimate, and the latter as much beyond the fourth. The extremities of the crests extend obliquely to their bases, and support four or five dentiform processes. The dense shining layer extends inwards as far as the bases of the serrate portions. The inner face of the anterior crest is oblique, and the posterior inner border curves outwards to behind the first crest, leaving a shelf-like continuation of the palatal surface of the tooth.

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* Proceed. Amer. Philos. Soc., 1877, p. 192.

Measurements.	M.
Length of tooth	.038
Width at third crest	.015
Depth opposite third crest	.004

This species must be compared with *C. fossatus* Cope, and *C. serratus* Newb. The latter is a wide tooth with less oblique, and fully serrate crests. The former is a narrow species, but the anterior crests are not nearly so extended; it is deeper, and the inner side is vertical, and without the posterior palatal lamina seen in the two species named.

CTENODUS DIALOPHUS. Sp. nov.

Represented by a single left tooth in excellent preservation. Its characters are very marked. It is of narrow form, and has more numerous crests than any other known American species. They number ten, and there are two or three other rudimental ones at the posterior extremity. They are all more transverse than usual, five being directed forwards, and five slightly backwards. The crests are acute, but the grooves and emarginations are not very deep. The crests are entire, except at the obliquely truncate distal extremities, where there are from two to four dentations. The shining layer does not extend within these. The inner border of the tooth is vertical, excepting posteriorly, where the inner border of the crest-bearing portion turns outwards, leaving a narrow ledge of the palatal face. The latter is concave in cross section.

Measurements.	M.
Length (.004 at one end inferential)	.033
Width at fifth crest	.010
Depth opposite fifth crest	.004

It is not necessary to compare this species with any other.

OBSERVATIONS ON THE PELYCOSAURIA.

In addition to the type of humerus described under the head of the genus *Clepsydrops*, several other remarkable forms occur in the collection, which are probably referrable to the various genera of *Pelycosauria*. I give the following tabular analysis of them:

A. No condyle; a supracondylar foramen. No special proximal articular surfaces.

No. 1. (*Clepsydrops*) .... Specimens, 5.

AA. Condyles and supracondylar foramen.

a. The shaft uninterrupted.

No. 2. Condyles longer; smaller .... Sp. 6.

No. 3 Condyles wider; larger .... Sp. 4.

aa. The shaft interrupted by a prominent diagonal ridge.

No. 4. Epicondyles and ridges enormous..........................Sp. 1.

AAA. No supracondylar fossa; condyles as in *AA.*

No. 5. Form more slender..Sp. 3.

No. 6. Form more robust...Sp. 1.

The above humeri represent three, and perhaps four genera, which have been probably already named from crania or vertebræ in the preceding pages. No. 1 has been already identified as belonging to the *Clepsydrops natalis.* Nos. 2 and 3 are generally similar to the type referred by Meyer to the *Eurosaurus* of Fischer, which had been previously described as Mammalian by Kutorga; but the epicondyles are more largely developed. Humerus of form No. 4 is very remarkable, resembling in some degree that of a mole, being exceedingly robust, and having the muscular insertions enormously developed. It doubtless belonged to a fossorial animal, possessing great power in the anterior limbs. If we search for vertebræ presenting features corresponding to such a mode of life, we sieze at once on those of the genus *Empedocles.* Here the elevated roof-like character of the zygapophyses and the connecting platform suggest protection against superincumbent weight, while additional strength is obtained by the hyposphen articulation below them. The short wide neural spine is highly appropriate also to subterranean habits. It is also probable that the animals possessing the humeri, from No. 2 to No. 6 inclusive, were all more or less fossorial. Humeri Nos. 5 and 6 have the characters of Nos. 2 and 3, but the supracondylar bridge is wanting, and the internal epicondyle not quite so much expanded.

The division *Pelycosauria* is established primarily on the genera *Clepsydrops* and *Dimetrodon,* but their cranial structure renders it highly probable that *Ectocynodon, Pariotichus* and *Bolosaurus* belong to it. It is also probable that the genera *Empedocles, Embolophorus* and others determined from vertebræ belong to it, as the latter are frequently accompanied by pelvic bones of the type of that of *Dimetrodon.* All the genera known from teeth and crania, are of carnivorous habit, excepting *Bolosaurus* and *Diadectes;* they may be referred to a single family on this account, which I call the *Clepsydropidæ.* *Bolosaurus* will form the type of another family characterized by the transverse position of the crowns of the teeth, under the name of *Bolosauridæ.* Prof. Owen has named a group of Triassic and Permian reptiles the *Theriodonta,* characterized by the mammal-like differentiation of the incisor and canine teeth. The animals thus referred by Prof. Owen probably enter my suborder of *Pelycosauria,* although the structure of their pelvis remains to be ascertained. If so, they correspond with my *Clepsydropidæ,* since Prof. Owen does not include herbivorous forms in his division. As it is plain that the herbivorous and carnivorous types belong to the same order, and probably suborder, it becomes necessary to subordinate the term *Theriodonta* to that of *Pelycosauria.* To another division of reptiles from the South African Trias typified by the genus *Pareiasaurus* Ow., he gives a special name, expressive of the deeply impressed surfaces of the centra occupied by the remains of the chorda dorsalis. As this, or the perforate condition, is characteristic of all of the *Pelycosauria*, it is probable that it is present in Prof. Owen's *Therodontia* also. It is also evident that since the dental characters of *Pareiasaurus* do not serve to distinguish it as an order from the genera with distinct canine teeth, this group also must be looked upon as a subdivision, perhaps of family value, of the *Pelycosauria* or other parts of the Rhynchocephalous order.

The Texan genera of this group, so far as yet known, are about equally related to the Ural and South African types. The age of the former deposit is the Permian, which includes, according to Murchison, the Todtliegende and Zechstein of Thuringia. The age of the South African beds is uncertain, but is suspected by some authors to be Triassic, and by Owen to be Palæozoic. In discussing the age of the *Clepsydrops* shales of Illinois, which had been referred to the coal measures by all previous investigators, I left the question open as to whether they should be referred to the Permian or Triassic formations.* The evidence now adduced is sufficient to assign the formation, as represented in Illinois and Texas, to the Permian. Besides the saurian genera above mentioned, the existence of the ichthyic genera *Janassa*, *Ctenodus* and *Diplodus*, in both localities, renders this course necessary.

THESES.

1. The horizon of the *Clepsydrops* shales of Illinois and corresponding beds in Texas is Permian.

2. That this period witnessed an abundant life of land and ichthyic vertebrata, the former consisting of Rhynchocephalian reptiles and Stegocephalous *Batrachia*.

3. That in the land vertebrata of this period, the amphiplatyan, procœlous, and opisthocœlous types of vertebral articulation were unknown, and that the vertebral centra are either deeply amphicœlous or notochordal.

4. That in the case of both the *Rhynchocephalia* and *Stegocephali*, a specialized dentition, and in the former order, a specialized limb structure, were superadded to this imperfect vertebral structure.

5. That in the primitive land *Vertebrata* of the Permian, the place of the vertebral centrum was occupied by two elements, the centrum and intercentrum.

6. That the intercentrum, from a position of primary importance, as in *Rhachitomus* and *Trimerorhachis*, became reduced, and finally mostly obliterated, but that it remains at the present day in the anterior dorsal region of some *Lacertilia*, and as the chevron bones of most reptiles and some mammals.

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* Proceedings Academy Philadelphia, 1875, p. 405.

Some Microscopical Observations of the Phonograph record.

BY PERSIFOR FRAZER, JR., A. M.

(*Read before the American Philosophical Society, April 5th,* 1878.)

As soon as the first wonder and delight at the performance of the phonograph had commenced to subside, physicists immediately set about thinking in what way this instrument could aid in their general researches.

This wonder was very natural, and it was greatest among those most versed in acoustics ; for it was a curious question why, with all the elaborate and delicate apparatus in the world, with the profundity of its designers, and the ambition of its employers ; with the attention of mankind directed so long to the problem of producing inanimate articulate speech ; and after the production of a permanent record of the characters of the sound waves of human voice upon smoked glass, no one had hit upon so simple an expedient for producing a record, which can be used to reproduce the sound.

The apparatus which Mr. Edison has employed is a cylinder covered with thin foil on which the blunted end of a needle or stylus impinges. The impression made by the point of the needle in the soft lead paper depends upon the path which that point was describing at the moment when the impression was made. By turning the cylinder with uniform motion so that the needle traverses a helical groove traced on its surface, at the same rate both when speaking and causing the instrument to speak ; the point of the stylus will travel over the same or nearly the same path, and the motions transmitted by the point to the centre of the diaphragm will be nearly the same in kind (though feebler in force) as before.

It was natural at once to think of investigating the forms left by the stylus in the soft lead foil under the microscope, and this has been done.

The following remarks are offered simply as a small contribution to an investigation which is clearly destined to occupy the minds of some of the ablest physicists for a long time to come.

By the kindness of Dr. Plush (Superintendent of the Philadelphia Local Telegraph Company), the following experiments were tried on his apparatus : After repeating the vowels and dipthongs A (ah), Ē (ay), Ī (ee), Ō (oh), Ū (oo), OI, OW, ă (as in *hat*), ĕ (as in bed), ĭ (as in *him*), ŏ (as in *Tobias*), ŭ (as in *put*), frequently enough to produce as uniform a result as possible, Dr. Plush spoke them into the mouth-piece, leaving spaces between each vowel and the end of the series ; so that there was no difficulty in picking out the different sound-records.

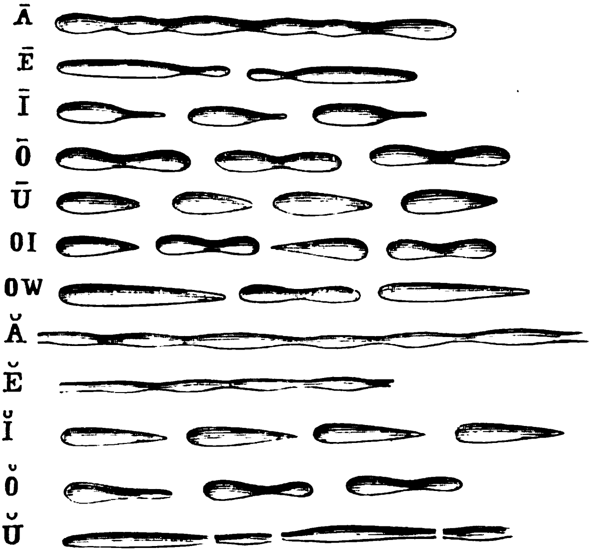
This record was then allowed to speak (its pronunciation being carefully noted and where necessary improved by another trial) two other records were added, thus filling up one sheet of the foil or matrix. When the articulation was deemed satisfactory the following records after having been made, were not subjected to the touch of the stylus for fear of obliterating or partially obscuring them.

These matrices were mounted on slips of glass, and were carefully examined under a low power of the microscope, the beginning and end of the record made by each vowel-sound being designated, by the letter appropriate to it.

In order to exhibit these records, a further modification of the mounting was made. The separate sounds were cut from the glass, separated. and glued in vertical lines upon the glass.

By means of reversing the direction of the projecting microscope and illuminating this record strongly by the condensers alone (a system of megascope projection well performed by Mr. Holman, of the Franklin Institute), not only are the impressions on the foil rendered distinctly visible but a line of them can be brought into focus at once and their local and accidental, compared with their fundamental and important differences.

The wood cut below will explain the nature of these differences :



*The characteristic of the sound Ā will be observed to be an alternation of

* Ten days after the above observations were made my attention was called to an article of Prof. Mayer, on the Phonograph in the last number of the *Popular Science Monthly*, in which he figures the impression made by "a" in bat and compares the section of the depressions made by the stylus in vibrating to this vowel with the shape assumed by the König's flame to the same sound.

There is one impression more on this record of Prof. Mayer than on the matrix which was the basis of these remarks; nor in the latter are the "dots and dashes" separated from each other so completely as thus seems to be in his experiment.

one long and two short sounds. Under the conditions of the experiment then it may be said to be dactylic (or anapæstic). In the cut there are two shorts followed by one slightly longer, and this twice repeated, though it is extremely probable that one set (i. e. one long and two short) constitute one complete excursion of the stylus which produces the sound. Ē resembles in the figure two Indian clubs laid with the handles together. This is the general character whenever seen, though the size and shape of the component parts are subject to variation.

In Ĕ there is in the cut but an indistinct resemblance to this apparently fundamental character. I have preferred, however, to have the drawing made without any bias by a third person rather than risk touching it to agree with an hypothesis. After viewing many scores of these dents and comparing them with the long Ē, I have no hesitation in saying that the forms are the same though much lighter. This latter fact is also attested by the manner in which the dents are run together, for this shows that the intensity of the sound was not great enough to cause a vibration which would clear the point of the stylus from the foil. The result is that the groove is continuous and the parts analogous to the depressions in long Ā are indicated by a widening of the groove.

The general resemblance between Ī and Ĭ is clear. As the drawings are not made to scale (the more accurate measurements being supplied below) the greater thinness of the characters impressed upon the foil by the light sounds does not distinctly appear. The appended micrometric measurements will, however, give information on this head.

Ō and Ŏ are like each other and unlike any of the rest, the shorter sound conforming to the rule above mentioned.

The same remarks will apply to a comparison of Ū and Ŭ that were made above in relation to Ĕ. A general resemblance with the short sound though the depressions are more tenuous is evident in OI.

A strong corroboration of the correctness of these symbols as indicating the given sounds with the especial conditions employed lies in the appearance of the record for OI, which is clearly seen to be made up of "*O*" "*ee*" or as pronounced O I.

OW resembles "o" "u" strikingly.

It will be remembered that this drawing is not absolutely but approximately accurate. No scale or camera lucida was used.

Dr. E. J. Nolan, who was kind enough to draw the figures on wood, made his drawings entirely independently from myself, nevertheless they agree with those made by me in every detail except their better finish.

The narrow canals which separate or rather connect the larger depressions must be understood to result from the comparative quiescence of the point of the stylus at the moment when that point of the foil passed under it.

They are in fact nothing but the detached parts of the canal caused by pressing the point of the stylus into the helical groove. They may or may nor appear separating the different component parts of the same sound.

record or of different sound-records, according as the loudness of the sound and the consequent extent of the excursion of the stylus enabled that portion of the instrument to clear the surface of the foil during the rapid revolution of the cylinder.

According to any reasonable hypothesis, the light vowel sounds and the long or heavy vowel sounds should bear a general resemblance to each other; but the latter should be more completely run together. This appears on the record.

It was intended to take casts of the depressions in gelatine or Canada balsam, in order that all parts of the solid forms may be examined at once, but naturally the shape of the depressions have only a secondary bearing on the subject since they are result of the dragging down by the stylus of the yielding lead paper in passing over a mathematical line.

Different substances or the same substance at different temperatures would naturally produce casts of entirely different character.

The following are some measurements of the lengths and widths of some of these forms. The depth was not measured :

Ā (Ah)

	Millimeters.	
Length	5.187	(Mean of six measurements.)
Breadth	0.532	" "
Distance apart	0.606	" seven "

Ē (ay).

	Millimeters.	
Length 1st of couple (large end on left)	7.3416	Mean of three measurements.
" 2d of couple (large end on right)	6.916	(Mean of three measurements.)
" 1st of couple (Small end on right)	1.2078	"
" 2d of couple (Small end on left)	1.2078	"
Breadth	0.266 to 0.798	——
Distance apart of small ends	0.798	Mean of three measurements.
" of large end	0.2881	Mean of six measurements.

Ī.

	Millimeters.	
Length of depression neck	2.4738	Mean of three observations.
" Body	6.916	"
Greatest breadth	3.3416	"
Distance apart	1.862	Mean of three measurements.

ō.

	Millimeters.	
Length 1st of couple...........	4.123	Mean of four observations.
" 2d of couple..........	4.721	
Breadth......	3.99	Mean of three
Distance apart.................	1.4896	" "
" between two of a couple	0.532	

Ū.

	Millimeters.	
Length....................	8.0598	Mean of three measurements.
Greatest breadth.............	2.66	———
Distance apart................	3.192	Mean of three measurements.

OI.

	Millimeters.	
Distance apart................	0.864	(Mean of four determinations.)

OW.

	Millimeters.	
Distance apart................	1.596	(Mean of seven observations.)

ă.

	Millimeters.	
Length of long dent......	1.596	Mean of four measurements.
" 1st short dent..........	0.532	
" 2d " "	0.532	

ĕ.

	Millimeters.	
1st long depression.......... ..	2.926	Mean of five measurements.
1st short "	1.064	
2d " "	1.064	
2d long "	2.926	

ĭ.

	Millimeter.	Mean of five
Distance apart................	2.075	observations.

ŏ.

	Millimeter.	
Distance apart................	1.011	Mean of eight observations.

ŭ.

Distance apart...............	1.5561	Mean of eight measurements.

It would be well if a material could be discovered soft enough to offer the minimum resistance to the excavating action of the stylus, yet which could be hardened without distorting the shape of the depression.

Some Tables for the Interconversion of Metric and English Units.

BY PERSIFOR FRAZER, JR., A. M.

(Read before the American Philosophical Society, April 5, 1878.)

Capt. Kater, in 1821, as a member of the Royal Standard's Commission, appointed in 1818, made the determination of the meter to be 39.37079 inches. This was adopted by the Commission and was embodied into the statute of the British Parliament enacted in 1824, establishing the platinum standard meter in Paris as in length equal to 39.3708 inches of brass at the temperature of 62° Fahrenheit, the platinum standard being at 0° Centigrade, or 32° Fahrenheit, the temperature of melting ice.

Capt. Kater's value was again sanctioned by law in 1864.*

In 1866, the Royal Ordinance Survey, adopted 1 meter = 39.370432 inches, on the authority of Col. (then Capt.) A. R. Clarke, Superintendent of the Office of the Survey at Southhampton.

In 1869, the more recent Royal Standard's Commission, under the Presidency of Astronomer Royal Airey, reported comparative tables, founded on Kater's value, which were published in a Parliamentary Blue Book, and may be found at the end of the second Report of the Royal Standard's Commission, published in that year.†

The subjoined work was undertaken to supply a want which every physicist and chemist, and, indeed, very many artisans and manufacturers have felt, for a set of convenient and consistent tables for converting various values of measure and weight from one into the other of the two systems between which at present the calculations of the greater part of the civilized world, both in science and trade, are divided.

Every one knows that a multitude of tables for this object are already in existence, yet it must be apparent to any one who has compared them together that there are generally discrepancies between them.

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* When the use of the metric sytem was rendered permissive in Great Britain so far as related to contracts.

† Extracts from a private letter from President F. A. P. Barnard, of Columbia College, New York.

For instance, three authorities which should command the confidence of scientific men give the following values:

	Rankine.	Crookes.	Eliot & Stover.
Grains in a Gram.........	15.43235	15.438395	15.4346
Cubic meters in 1 cubic foot	0.0283153	0.028314	....
Tonnes in a ton..........	1.01605	1.015649	....
Kilos. per sq. centimeter in one pound per sq. inch..	.0703095	.0702774	....

Only three authorities are here quoted, but the number might be almost indefinitely increased. It is true that for most purposes these differences being less than one thousandth of one per cent., would not seriously affect the results; but there are problems continually occurring where some recognized equivalent is most desirable, and still a greater number where it is desirable that all the diverse terms employed should have been obtained from the same original unit and by the same methods.

It would be far better that all the English speaking world should accept a wrong determination as the only legal one than that each person who employs such reciprocal values should take a different standard, even if one of the number could be *absolutely* right.

In all questions relating to the value of lineal, superficial and cubical equivalents of the English and Metric units, including those defined by law as a certain whole number and fraction of cubic inches or feet (*e. g.* the bushel, barrel, stone-perch, &c.), the determination of Kater has been taken, and squared, cubed, multiplied and divided until the expression for the desired derivative of the meter was obtained in terms of some derivative of the inch, no decimals having been omitted until the final number was reached; when the shorter approximative expression has been substituted by an application of the well-known rules governing such cases.

The number of decimal places given has been in proportion to the importance of the unit as a base from which to calculate other values. Thus the number of places in the Grain–Gram equivalents is eleven (as in the report of Mr. Upton, from which it was taken), whilst the Rood–Are being less frequently used and especially being of less importance as a base from which to derive other values, is given in five and six places respectively.

This method of separate calculation from the fundamental Inch-Meter value has been employed for each of the above-mentioned kinds of dimensions, and the value of the metric unit in the Inch derivative has been converted into the reciprocal or Inch derivative unit by simply dividing the whole decimal into one and shortening as before. This is obviously to be preferred to taking the reciprocal of the legal value of the meter in inches, as the base of the calculation.

Crookes' (Select Method of Chemical Analysis) was drawn on for the form of expressing the Fahrenheit in the Centigrade degree. **Rankine** is responsible for the statement of the relation between English Heat Units and French Calories, but both have been verified.

In weight the fundamental units (the value of the Gram. in Grains) is taken from the report of Mr. Upton (Chief Clerk of the Treasury) to Hon. John Sherman, Secretary, March 26, 1878, and from this value all the others were calculated.

In fine, all the values here appended have been as carefully as possible revised by the author, and, in addition, have had the benefit of the very valuable criticism and corrections of Professor Chase, of Haverford College, and of President Barnard, of Columbia College, the latter of whom has conferred greater security in verifying them by the calculating machine.

In the case of lineal units, four of those most constantly recurring were selected, and the values of one up to nine times each unit are given in terms of the other. This method, which is employed in Crookes' "Select Methods of Chemical Analysis" (London, 1871,) permits any decimal multiple or fraction of one unit to be obtained with great accuracy in terms of the other, by a change of the decimal point and a simple addition.

Thus, if it be required to find the number of inches in 348$\frac{4}{25}$ centimeters, the fraction would first be written decimally, 348.16. The value in inches of three centimeters is 1.181124.

		INCHES.
300	centimeters would equal.................	118.1124
40	“ “ “	15.74832
8	“ “ “	3.149663
0.1	“ “ “	0.03937079
0.06	“ “ “	0.02362247
348.16	“ “ “	137.07337626

For area, capacity and weight, the value of only one unit of each is given in terms of the other, and a simple multiplication will give any number of times such an unit.

The value of the meter in inches is given by Mr. Upton, Chief Clerk of Treasury Department, in the report before mentioned, as 39.370432, and consequently the values here given do not agree with those for length, area, surface or capacity in that report.

The same unit which he gives for the gram in grains is adopted here, so that the column of weights should accord.

TABLES

FOR THE

INTERCONVERSION

OF

LISH AND METRIC UNITS.

BY

Persifor Frazer, Jr., A.M.,

ed to Am. Philosophical Society, April 5, 1878.

PHILADELPHIA.

inch water weighs = 252.7574 grains.
x. dens., Bar. 30 in. Air 62° F. (Barnard.)
c foot water weighs = 62.3949696 lbs.
(112 lbs.) = 50.80238 kilos.
er (28 lbs.) = 12.700595 "
m = 1.77185 grams.

LINEAL UNITS.

ES.		CENTIMETERS.	FEET.		METERS.
7079	=	1	1	=	0.3047945
	=	2.539954	3.2809	=	1
416	=	2	2	=	0.6095890
	=	5.0799	6.5618	=	2
124	=	3	3	=	0.9143835
	=	7.6199	9.8427	=	3
832	=	4	4	=	1.2191780
	=	10.1598	13.1236	=	4
539	=	5	5	=	1.5239724
	=	12.6998	16.4045	=	5
2247	=	6	6	=	1.8287669
6	=	15.2397	19.6854	=	6
5955	=	7	7	=	2.1335614
7	=	17.7797	22.9663	=	7
9663	=	8	8	=	2.4383559
8	=	20.3196	26.2472	=	8
3371	=	9	9	=	2.7431504
9	=	22.8596	29.5281	=	9

LINEAL UNITS.

DS		METERS.	MILES.		KILOMETERS.
1	=	0.9143835	0.6214	=	1
3633	=	1	1	=	1.6093
	=	1.8287669	1.2428	=	2
73	=	2	2	=	3.2186
	=	2.7431504	1.8641	=	3
09	=	3	3	=	4.8279
	=	3.6575340	2.4855	=	4
45	=	4	4	=	6.4373
	=	4.5719174	3.1069	=	5
82	=	5	5	=	8.0466
	=	5.4863009	3.7283	=	6
18	=	6	6	=	9.6559
	=	6.4006845	4.3497	=	7
54	=	7	7	=	11.2652
	=	7.315068	4.9711	=	8
91	=	8	8	=	12.8745
	=	8.2294514	5.5924	=	9
27	=	9	9	=	14.4838

AREA.

SQ. INCH.		SQ. CENTIMETER	SQ. FEET.		SQ. METER.
1	=	6.451367	1	=	0.09290
0.1550059	=	1	10.76393	=	1

SQ. YARD.		SQ. METER.	SQ. YARDS.		ARE.
1	=	0.8360972	1	=	0.00836097
1.19603326	=	1	119.603326	=	1

ROOD.		ARE.	ACRE.		HECTARE.
1	=	10.11678	1	=	0.404671
0.098845	=	1	2.471143	=	1

THERMOMETER.			HEAT UNITS.		CALORIES.
FAHRENHEIT DEGREES.		CENTIGRADE DEGREES.	1 LB. WATER 1° FAH.		1 KILOGRAM WATER 1° CEN.
1	=	0.55556	3.96832	=	1
1.8	=	1	1	=	0.251996

CAPACITY.

CUBIC INCHES.		CUBIC CENTIMETERS.	CUBIC FOOT.		CUBIC DECIMETER. (Liter.)
1	=	16.38617589	1	=	28.315312
0.06102705152	=	1	0.03531658	=	1

CAPACITY.

CUBIC FT.		CUBIC M. (Stere.)	CUBIC YD.		CUBIC M. (Stere.)
1	=	0.028315	1	=	0.764513470
35.31658	=	1	1.3080215	=	1
MINIM.		CUB. CENT. M.	FLUID OZ.		CUB. CENT. M.
1	=	0.0616082	1	=	29.5719289
16.23158	=	1	0.033815	=	1
U. S. PINT. (WINE).		LITER.	U. S. GAL. 231 C. I.		LITER.
1	=	0.47315083	1	=	3.7852067
2.1134908	=	1 a	0.264186	=	1
U.S. WINE BL. (31.5 Gals.)		LITER.	GAL. (IMP.)		LITER.
1	=	119.234017	1	=	4.54345728
0.00838686	=	1	0.2200967	=	1
U. S. BUSHEL. (2150.42 C. I.)		LITER.	CORD.		STERE. (Cubic Meter.)
1	=	35.2371556	1	=	3.624360
0.028379135	=	1	0.275911	=	1

SOLID PERCH. (25 CUB. FT.)		CUBIC M. (Stere.)
1	=	0.7078828
1.412663	=	1

WEIGHT.

POUNDS TO FOOT.		KILOS TO METER.	POUNDS TO SQ. INCH.		KILOS TO SQ. CENTIMETER.
1	=	1.48819	1	=	0.0703096
0.6719572	=	1	14.22282	=	1
GRAINS.		GRAMS.	POUNDS. (Av.)		KILOGRAMS.
1	=	0.06479895036	1	=	0.453592653
15.43234874	=	1	2.2046212	=	1
OZ. (AV.)		GRAMS.	LBS. TROY.		KILOGRAMS.
1	=	28.349541	1	=	0.373241954
0.035274	=	1	2.679227	=	1

TONS.		TONNES. (1000 kilos.)
Long (2240 lbs.)	=	1.0160475
Short (2000 lbs.)	=	0.9071853
Long. 0.9842059 Short 1.1023106	=	1

GRAINS PER U.S. GALLON.		MILLIGRAMS PER LITER.	FOOT POUNDS.		KILOGRAMETER.
1	=	17.1189987	1	=	0.138253
0.05841463	=	1	7.23314	=	1

Revision of the Species of the Sub-family BOSTRICHIDÆ *of the United States.*

BY GEORGE H. HORN, M.D.

(*Read before the American Philosophical Society, April 19th,* 1878.)

The species here treated of have never been the subject of a special paper, most of them having been described in separate memoirs many years apart and by the older authors in such a manner as to leave their descriptions of no value from the accumulation of new species.

There is nothing to be added in their generic and tribal arrangement, to that already given by Dr. LeConte, in the Classification of the Coleoptera of North America, I merely content myself with copying his tables.

The three tribes indicated are as follows:

Thorax with distinct and entire lateral margin............**Endecatomini.**
Thorax without lateral margin.
  Head covered by the prothorax which is asperate in front....**Bostrichini.**
  Head free, thorax not roughened in front....................**Psoini.**

Tribe ENDECATOMINI.

The head is in great part covered by the prothorax, and is more decidedly retracted than the other genera of the sub-family, approaching in this respect the Anobiadæ, with which it also agrees in having the thorax completely margined from base to tip. The antennæ are eleven jointed, terminated by a rather loose tri-articulate club, the intermediate joints 3–8 are longer than wide and together much longer than the first two joints or the club. The anterior coxæ are contiguous. The tibiæ are slender not dentate externally and terminated by spurs, those of the anterior tibiæ stout and rather long. The tarsi are short, the first joint small but distinct in the males, connate with the second in the female, so that in the latter sex the tarsi are but four-jointed. The last joint of the tarsi is nearly as long as the preceding together.

This tribe forms the connecting link between the Anobiadæ and Bostrichidæ, with greater resemblance in its structure to the former than the latter, and contains but one genus.

ENDECATOMUS Mellié.

Two species occur in our fauna.

E. reticulatus Herbst (*Anobium*) Käfer, v, p. 70, which has probably been introduced from Europe, and

E. rugosus Rand. (*Triphyllus*) Bost. Journ. II, p. 226; *dorsalis* Mellié, Ann. Fr. 1848, p. 218,

Color dark brown opaque, surface sparsely pubescent. Head finely and densely granulate. Thorax densely and more coarsely granulate with pale brownish hairs arranged in sinuous lines. Elytra with small granules arranged in anastomosing lines, the spaces between them smooth, their summits with pale brownish pubescence.

In these respects the two species agree.

E. reticulatus is somewhat more elongate, the under surface quite conspicuously granulate and the male with two small frontal tubercles. Length .18 inch ; 4.5 mm.

Occurs in the Southern States.

E. rugosus is more robust and with the under surface obsoletely granulate and the male without frontal tubercles. The upper surface is rather more conspicuously pubescent. Length .16 inch ; 4 mm.

Occurs everywhere in the region east of the Rocky Mountains.

Tribe BOSTRICHINI.

The insects of this tribe are all of cylindrical form and of moderate or small size. The eyes are prominent and behind them the head is moderately prolonged. The thorax is prolonged over the head, completely concealing it from above, covered in front with asperities and often prolonged at its anterior margin in two unciform processes ; the sides are not margined. The antennæ are short, terminated by a three-jointed loose club (four-jointed in *Tetrapriocera*), and may have nine, ten or eleven joints, ten being the normal number. The anterior coxæ are contiguous, their cavities confluent.

The genera are as follows :

Intermediate joints of antennæ shorter than the first and second.
  Tarsi long, slender, first joint very short.
    Antennæ with a three jointed club ....**Sinoxylon.**
    Antennæ with a four-jointed club ....**Tetrapriocera.**
Intermediate joints of antennæ longer than the first and second.
  Tarsi as long as the tibiæ, slender, second joint long.
    Front margined, at the sides at least.......................**Bostrichus.**
    Front not margined ....**Amphicerus.**
  Tarsi short, second joint not elongated.....................**Dinoderus.**

SINOXYLON Dufts.

The species of this genus are of a cylindrical form. The head is completely concealed from above by the thorax, which is truncate in front, the apex covered with asperities, while posteriorly the surface is smooth and punctured. The elytra are cylindrical, obliquely truncate posteriorly, and in many of the species tuberculate or dentate, their sculpture varying with the species ; the surface is punctured with but a feeble attempt at a striate arrangement. Several of the species have a distinctly impressed sutural stria near the declivity.

Our species divide themselves into two groups which might be considered genera. I do not think science would be materially benefited by a new name, and I therefore leave them as they have been. These groups are based on the number of the small joints of the antennæ between the second joint and the club; these may be either five or four, so that in one case the antennæ are 10, in the other 9-jointed.* In the latter case the front has a semicircular row of erect hairs after the manner of *Scolytus*, while in those with 10-jointed antennæ this structure does not exist. The arrangement of the tubercles is also different in the two groups, this is spoken of further on.

Our species may be tabulated in the following manner:

A. Antennæ 10-jointed. Elytra with tubercles around the declivity.
  Last two joints of maxillary palpi equal. Larger species.
    Declivity of elytra coarsely punctured, on each side trituberculate.... **basillare.**
    Declivity impunctured, on each side bituberculate.......... **sericans.**
  Last joint of maxillary palpi longer than the preceding. Smaller species.
    Declivity on each side trituberculate and
      with a few coarse punctures. Front of ♂ bituberculate..**texanum.**
      smooth. Front of ♂ quadrituberculate.......... **sextuberculatum.**
    Declivity on each side bituberculate, smooth......... **quadrispinosum.**
    Declivity not tuberculate nor margined................ **dinoderoides.**
B. Antennæ 9-jointed. Elytra with tubercles on or near the suture.
    Declivity coarsely punctured, sutural striæ deeply impressed posteriorly, the two diverging in the declivity, each partly surrounding an acute juxta-sutural acute tubercle.......................... **bidentatum.**
    Declivity smooth along the suture, and at the upper part a small acute tooth formed by the sudden elevation of the suture........ **declive.**
    Declivity smooth along the suture, the latter slightly triangularly elevated at the middle of the declivity..................... **suturale.**

S. basillare Say, (*Apate*) Journ. Acad. III, p. 321; ed. Lec. II, p. 181.

A common species in the Atlantic States and at times very destructive to hickory-wood.

The characters in the table will readily distinguish it from any other, excepting possibly *texanum*, the palpi being at times difficult to observe. It is however larger in size and with the declivity more coarsely and densely punctured. The absence of any tubercles on the head may however be a sexual character. Length .24 inch; 6 mm.

S. sericans Lec. ♂ Proc. Acad. 1858, p. 73; *asperum* Lec. ♀ loc. cit.

A rather more robust species than *basillare*, with the elytral punctures becoming gradually coarser from the base to the declivity. The apex is rather abruptly declivous and impunctured and with two tubercles on each side, the upper being the more prominent. Length .24 inch; 6 mm.

The male has a vertical tooth arising from the upper side of the left mandible.

Occurs from from Texas to Cape San Lucas.

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* NOTE.—These species bear the same relation to the 10-jointed *Sinoxylon* that *Enneadesmus* does to *Xylopertha*. Another parallel case will be found further on.

S. texanum, n. sp.

Cylindrical, moderately robust, piceous, shining, thorax and elytra at base rufous. Head densely punctured, vertex with two minute tubercles between the eyes. Thorax slightly wider than long, anteriorly acutely asperato-granulate, posteriorly moderately densely and finely punctured. Elytra coarsely punctured and with two intervals moderately distinct, slightly sub-carinate at base and at tip terminating in the two upper tubercles, tip rather suddenly declivous and punctured on each side, acutely trituberculate, the lower tubercle more prominent. Antennæ and femora pale, tibiæ piceous. Length .14 inch ; 3.5 mm.

This species greatly resembles *sextuberculatum* but is usually a little larger and the declivity has a few coarse punctures. The head of the male has two dentiform tubercles on the vertex, while there are four in the other species.

Occurs in South-western Texas.

S. sextuberculatum Lec. Proc. Acad. 1858, p. 73.

In color and sculpture this species agrees for the most part with the preceding. There are not, however, the sub-costiform intervals, and the declivity of the elytra is smooth and without punctures, on each side acutely trituberculate. Length .14–.16 inch ; 3.5–4 mm.

The male has four minute tubercles on the vertex arranged in an arcuate line between the posterior margins of the eyes. The head of the female is plain.

Occurs in California, near Fort Yuma, and probably depredates on the Mesquit.

S. quadrispinosum Lec. New Species, 1866, p. 100.

Resembles the preceding in form and color. The thorax in front is acutely tuberculate, posteriorly very sparsely and finely punctured. The elytral punctures are finer at base gradually coarser posteriorly, the declivity is smooth and on each side two equal, conical tubercles. The legs and antennæ are pale, the front tibiæ alone piceous. Length .16 inch ; 4 mm.

Occurs in Lower California and Arizona.

S. dinoderoides, n. sp.

Rufo-piceous, feebly shining, cylindrical. Head densely punctured. Thorax as broad as long, asperato-granulate in front, posteriorly moderately densely punctured. Elytra moderately densely but not coarsely punctured, declivity convex, not margined nor tuberculate, suture elevated. Body beneath moderately densely punctulate. Length .16 inch ; 4 mm.

This species has entirely the form of its congeners excepting the absence of margin to the declivity. It is however one of those cases in which it is rather difficult to decide the generic position. The intermediate joints of the antennæ 3–7 are short and scarcely as long as the first two, and the club (joints 8–10) is rather closer than that of any of the others. With these differences noted, I place it in the present genus rather than in *Amphicerus* where its specific name appears in the Check List.

Two specimens ; Camp Grant, Arizona.

S. bidentatum, n. sp.

Piceous, thorax and elytra at base rufous. Head punctured, front with a semicircle of yellowish hairs. Antennæ pale, 9-jointed. Thorax slightly broader than long, asperato-granulate in front, smooth and very sparsely punctulate behind. Elytra gradually more coarsely punctured from base to tip, sutural stria near the declivity finely impressed, on the declivity very deeply impressed and arcuate, and surrounding a sub-sutural acute tubercle on each side near the middle of the declivity ; a slight tuberosity is also formed by the interruption of the margin of the declivity near the tip. Legs piceous, anterior femora testaceous. Length .16 inch ; 4 mm.

This species in appearance is not very different from *quadrispinosum*, but the bispinous and coarsely punctured declivity and 9-jointed antennæ will readily distinguish it.

One specimen from Nebraska.

S. declive Lec. Pacif. R. R. Rep. 47 par. App. 1, p. 48.

A large species of the form and size of *basillare* with the elytra usually uniformly piceous. The head has the semicircular line of yellow hairs. The thorax roughened in front and sparsely punctured posteriorly. The elytra are more coarsely punctured posteriorly than in front, and there is a sutural stria posteriorly rather deeply impressed but not entering the declivity ; the suture is slightly elevated at the beginning of the declivity, forming an acute tooth ; the declivity has a broad smooth space on each side of the suture. The legs and antennæ are pale testaceous, the tibiæ darker. Length .24 inch ; 6 mm.

Occurs in California and Oregon.

S. suturale, n. sp.

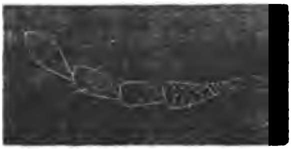
Form and color of *bidentatum*. Head punctured and with a semicircle of pale hairs. Thorax slightly broader than long, apex asperato-granulate, posteriorly nearly smooth, sparsely and finely punctured. Elytra rather finely punctured at base, gradually more coarsely toward the tip, declivity coarsely punctured in front, smooth on each side of the suture near the tip, the suture at the middle of declivity slightly triangularly elevated. Legs and antennæ pale, tibiæ darker. Length .16 inch ; 4 mm.

This species has also 9-jointed antennæ.

One specimen ; Sauzalito, California ; James Behrens.

TETRAPRIOCERA, n. g.

Form of *Sinoxylon*. Head covered by the prothorax. Clypeus and oral organs of *Sinoxylon*. Antennæ eleven-jointed, terminated by a four-leaved club ; first joint stout, second oval, half the length of the first, joints 3–7 short, indistinct, gradually broader, the seventh more than a half broader than the third, the whole taken together not longer than the first joint and but little longer than half the eighth, the latter elongate-triangular with the anterior free angle rounded, the last



three elongate-oval; each as long as the eighth, the four (8–11) with short erect hair sparsely placed.

This species is separated from *Sinoxylon* solely on account of the structure of the antennæ, the eleven joints together with the presence of *four* dilated terminal joints appearing to be too great a divergence from the type of that genus to permit its admission there.

T. Schwarzi, n. sp.

Cylindrical, shining, rufous, apex of elytra piceous. Head finely granular, front bituberculate (♂ ?). Thorax as broad as long, slightly narrowed in front, sides feebly arcuate, apex truncate, anteriorly with spiniform tubercles, one of which on each side at apical margin is unciform, disc at middle finely tuberculate, at base and sides sparsely and finely punctured. Elytra irregularly punctate, punctures neither coarse nor dense, declivity flattened, margined at tip and above on each side obtusely trituberculate, surface densely and coarsely punctured. Body beneath rufous, sparsely punctate. Legs and antennæ rufous. Length .18 inch; 4.5 mm.

One specimen taken by Dr. E. A. Schwarz, at Capron, Florida, another from the Island of Santo Domingo from Mr. W. M. Gabb.

BOSTRICHUS Geoff.

The essential difference between this genus and *Amphicerus* is in the occurrence of a slight frontal margin, which is sometimes evident only at the sides over the insertion of the antennæ. There is nothing special in the facies which can be relied on to assist the discrimination of the two. The hind angles of the thorax are always prominent, but there is one *Amphicerus* in which this also occurs.

Our species may be known by the differences given in the following table.

Thorax in front with two unciform processes.
  Elytra bicostate, vestiture scale-like........................**bicornis.**
  Elytra with one short basal costa, vestiture hairy..............**armiger.**
Thorax in front simply emarginate or truncate.
  Vestiture of elytra consisting of spots of pubescence irregularly placed.
    Thorax truncate in front..........................**truncaticollis.**
  Vestiture consisting of very sparsely placed, scarcely observable pubescence. Thorax emarginate in front....................**californicus.**

B. bicornis Weber, (*Apate*) Obs. Ent. p. 91; Say, Journ. Acad. III, p. 319; *serricollis* Germ. Ins. Spec. nov., p. 464.

Piceous, sub-opaque, surface clothed with yellowish scales aggregated in irregular patches. Thorax prolonged in front in two unciform processes which are serrate, between them the apex is truncate, apical region roughly granulate, posteriorly with smaller granules, median line distinctly impressed, hind angles prominent, surface sparsely scaly. Elytra bicostate, the inner costa stronger, surface densely cribrately punctured and clothed with yellowish scales in patches. Body beneath finely scabrous, sparsely pubescent. The anterior and middle tibiæ are feebly serrate, the posterior simple. Length .28–.48 inch ; 7–12 mm.

The male has an acute sub-sutural spine at the apex of each elytron, in the female the suture is merely slightly separated.

This species is so well known and common as hardly to need description, it is widely diffused over our country, but especially common in the Southern States.

B. armiger Lec. New Species, 1866, p. 100.

Elytra with trace of inner costa at base, coarsely cribrately punctured, the intervals tuberculate especially near the suture, surface clothed with yellowish hairs arranged in irregularly placed patches. Length .30–.40 inch ; 7.5–10 mm.

The sexual characters are as in *bicornis*, from which it differs in the absence of entire costæ, the tuberculate elytra and the vestiture being hairy and not scaly. Tibiæ as in *bicornis*,

Occurs in the Middle and Western States.

B. truncaticollis Lec. New Species, 1866, p. 101.

Piceous, sub-opaque. Thorax slightly longer than wide, apex (seen from above) truncate, without anterior processes, the anterior angles slightly prominent laterally, surface in front tuberculate, posteriorly granulate and sparsely pubescent, angles moderately prominent. Elytra not costate nor tuberculate, surface cribrately punctured and clothed with yellowish hairs arranged in irregular patches. Body beneath moderately densely punctulate and sparsely pubescent. Length .30–.40 inch ; 7.5–10 mm.

The male has a short sub-sutural spine, the female has the sutural angle slightly obliquely truncate. Tibiæ as in *bicornis*.

Occurs from Canada southward.

B. californicus, n. sp.

Black, sub-opaque, surface with very sparsely placed short hairs. Head granulate. Thorax emarginate in front and on each side serrate, surface rather coarsely tuberculate, median line distinctly impressed, hind angles rectangular, prominent. Elytra not costate, densely and coarsely cribrately punctured, the intervals elevated and moderately shining but not forming tubercles, surface very sparsely pubescent. Body beneath finely scabrous, sparsely pubescent. The anterior tibiæ are feebly serrate, the middle and posterior simple. Length .40 inch ; 10 mm.

The female has the sutural angle obtuse. Male unknown.

From its black color and the almost entire absence of pubescence, this species has quite a different appearance from the others.

One specimen ; San Joaquin Valley, California ; from Mr. Jas. Behrens.

AMPHICERUS Lec.

The differences between this genus and the preceding are very feeble, and will probably entirely disappear by the increase of species in the two genera. Here there is no frontal margin at all, and the antennæ are exposed at base.

Our species, with one exception, occur from the regions west of the Rocky Mountains, while the reverse is the case in *Bostrichus*. They are distinguished in the following manner:

Thorax with distinct hind angles..................................**fortis.**
Thorax with hind angles not prominent.
  Declivity of elytra distinctly margined at tip.............**punctipennis.**
  Declivity not margined.
    Surface with sparse recumbent pubescence...............**bicaudatus.**
    Surface with moderately long hairs. Form more slender.......**teres.**

A. fortis Lec. New Species, 1866. p. 101.

Cylindrical, robust, piceous black, shining. Thorax a little broader than long, apex with two hook-like processes pubescent at tip, in front roughly granulate, toward the anterior angles serrate, posteriorly densely granulate, smoother near the hind angles which are prominent. Elytra coarsely substriately punctured, declivity gradually convex, not margined nor callous. Body beneath sparsely punctulate, scarcely at all pubescent. Length .38–.68 inch; 9.5–17 mm.

This species is abundantly distinct from *punctipennis* by the prominent hind angles of the thorax, the form of the declivity and the almost entire absence of pubescence beneath. Crotch appears to have considered it the female of the next species, and for that reason omitted it from the Check List. I cannot convince myself that so many differences are sexual only.

Occurs from St. George, Utah to Arizona and Peninsula of California.

A. punctipennis Lec. (*Apate*) Proc. Acad., 1858, p. 73.

Cylindrical, robust, piceous black, shining. Thorax as long as wide anteriorly with two hook-like processes (not pubescent at tip), anterior face of thorax roughly granulate, at the sides serrate, posteriorly smoother granulations flattened, not prominent, hind angles not distinct. Elytra subseriately coarsely punctured, declivity slightly flattened, on each side two elongate callosities; at tip for a short distance acutely margined. Body beneath moderately densely punctate and clothed with fulvous pubescence. Abdomen densely punctulate with a few very large punctures intermixed, surface densely fulvo-pubescent. Length .46–.54 inch; 11.5–13.5 mm.

Occurs from Texas and Utah to New Mexico, Arizona, California, Peninsula California and Mexico.

A. bicaudatus Say, (*Apate*) Journ. Acad. III, p. 320; *aspericollis* Germ. Ins. Spec. nov., p. 258; *hamatus* Fab. *forte*, Ent. Syst. i, 2, p. 360; Syst. El. II, p. 380.

Cylindrical, moderately elongate, piceous brown, sparsely clothed with recumbent pubescence. Thorax as in *punctipennis* but with the hook-like processes smaller. Elytra moderately coarsely irregularly punctured, declivity oblique coarsely cribrate. Body beneath moderately densely punctulate. Abdomen densely punctulate with coarse punctures intermixed, surface moderately pubescent. Length .26–.40 inch; 6.5–10 mm.

The male has a moderately long process on each side of the declivity, in the female reduced to a small tuberosity.

Occurs everywhere east of the Rocky Mountains.

A. teres, n. sp.

Brownish piceous, cylindrical elongate, sparsely clothed with moderately long semi-erect pubescence. Front with moderately long erect yellowish hair. Thorax as broad as long, apex truncate without processes, anteriorly roughly punctate, toward the sides serrate, posteriorly substrigose, hind angles not evident. Elytra coarsely seriately punctured, declivity regularly convex, not margined nor tuberculate. Body beneath sparsely punctate and pubescent. Length .18–.22 inch; 4.5–5.5 mm.

In the two specimens before me I detect no sexual differences.

Occurs at Fort Yuma, California.

DINODERUS Steph.

The species of this genus are of cylindrical form, sometimes very slightly depressed. The thorax is covered with asperities in front in the manner usual to the genera of this tribe.

Here again we have a species (*brevis*) in which the antennæ vary from the normal number of joints, there being in the one species six and in the others five small joints between the second and the club. The second joint of the antennæ is usually nearly as stout as the first and short, in one species, however, (*punctatus*) this joint is much more elongate than usual as are also the third and fourth, this makes the antennæ longer and more slender; here also the antennæ are fimbriate anteriorly.

The length of the three-jointed club as compared with the funicle exhibits an amount of variation which indicates the propriety of suppressing the name of one or other of the generic names *Dinoderus* or *Rhizopertha*. The former is retained as it has the greater number of species in our fauna.

The surface of the body is sparsely clothed with short erect hairs, in *punctatus* alone the pubescence is not erect.

The declivity of the elytra is normally convex, two species have it flattened and limited to a varying extent by a ridge (*punctatus, truncatus*).

The other variations of structure are more strictly specific.

In accordance with the relative importance of the characters above given, our species may be arranged in the following manner:

A. Antennæ 10-jointed, form elongate cylindrical.
  Declivity of elytra convex, not acutely margined.
    Margin of thorax coarsely serrate.
      Head opaque, rather roughly granulate.................. **porcatus.**
      Head shining, smooth, granules small, flat............ **substriatus.**
    Margin of thorax feebly serrate.
      Elytral punctures irregularly disposed. Color piceous.

Declivity of elytra with simple punctures..............**cribratus.**
Declivity granulate or muricate.........................**densus.**
Elytral punctures in regular striæ. Color ferruginous....**pusillus.**
Declivity more or less flattened and acutely margined.
Second joint of antennæ as slender as the third, joints 3–8 hairy in front. Marginal ridge of declivity short..............**punctatus.**
Second joint of antennæ stout, joints 3–8 not hairy. Declivity flat and very abrupt, the marginal ridge long.............**truncatus.**
B. Antennæ 11-jointed, form short.
Margin of thorax not serrate, declivity convex................**brevis.**

D. porcatus Lec. New Species, 1866, p. 101.

Brownish opaque, sparsely clothed with short erect hair. Front opaque, roughly granulate. Thorax as long as wide, slightly narrowed in front, margin conspicuously serrate; disc in front with spiniform tubercles, posteriorly moderately densely tuberculate and with a fine smooth median line. Elytra striately tuberculate. Body beneath sparsely punctate. Length .14 inch; 3.5 mm.

Occurs from Pennsylvania southward and westward.

D. substriatus Payk. (*Apate*) Faun. Suec. III, p. 142; Mann. Bull. Mosc., 1858, III, p. 233.

Piceous, moderately shining, sparsely clothed with short erect hair. Front shining, sparsely granulate. Thorax as wide as long, a little narrowed in front; disc anteriorly with spiniform tubercles, posteriorly densely granulate, median line not evident; margin conspicuously serrate. Elytra with rows of coarse, deep, closely placed punctures, intervals submuricate. Body beneath shining, sparsely punctate. Length .16–.18 inch; 4–4.5 mm.

This and the preceding species are closely allied and differ only in sculpture. In the former the intervals are broken up into closely placed tubercles, in the latter the punctures of the intervals are more evident and the intervals are continuous, their summits being submuricate.

Occurs particularly in the Northern States and Canada.

D. cribratus Lec. New Species, 1866, p. 102.

Piceous, shining, sparsely hairy. Head shining, sparsely granulate. Thorax as wide as long, scarcely narrowed in front, margin very feebly serrate; disc in front with coarser tubercles, posteriorly, densely granulate, median line not distinct. Elytra with coarse, deep punctures, moderately, densely placed, feebly arranged in rows on the disc, confused at the sides, intervals not elevated. Body beneath sparsely punctate. Length .16 inch: 4 mm.

Occurs in the Middle States.

D. densus Lec. loc. cit.

Piceous, moderately shining, sparsely hairy. Front shining, sparsely granulate. Thorax as wide as long, margin very feebly serrate; disc in front roughly tuberculate, posteriorly densely granulate. Elytra densely and rather irregularly punctured, intervals sub muricate. declivity granulate. Body beneath sparsely punctate. Length .14–.16 inch ; 3.5–4 mm.

This species differs from the preceding in its rougher sculpture, and denser punctuation, the declivity in the former species being punctured, in this granulate.

Occurs in the Southern States ; also, in Michigan.

D. pusillus Fab. (*Sinodendron*) Ent. Syst. Suppl., p. 156 ; Stephens Illust. Brit. Ent. III, p. 354 ; Duval Gen. Col. Eur. III, pl. 57, fig. 281.

Cylindrical, brownish or castaneous, shining. Head very sparsely punctate. Thorax as broad as long, margin scarcely serrate, surface asperato-granulate in front, less roughly granulate posteriorly. Elytra with rows of coarse, deeply impressed, closely placed punctures. Body beneath moderately coarsely but sparsely punctate. Length .12 inch ; 3 mm.

This insect appears to be cosmopolite, having probably been distributed in articles of commerce. Numerous specimens were observed in the wheat at the Centennial Exposition. It probably occurs over our entire country, as I have specimens from Arizona.

D. punctatus Say, (*Apate*) Journ. Acad. V, p. 258.

Piceous, sparsely pubescent. Front sparsely punctured. Antennæ with moderately long hairs in front, the second joint as slender as the third and moderately long. Thorax a little longer than wide, narrowed in front, margin very feebly serrate, disc in front with spiniform tubercles, posteriorly indistinctly granulate, and more shining. Elytra densely and irregularly coarsely punctate, intervals not elevated, declivity feebly convex, suture slightly elevated, on each side a more prominent but small dentiform tubercle, at sides of apex acutely margined. Body beneath moderately densely punctate. Length .18 inch ; 4.5 mm.

This species is abundantly distinct in the structure of the antennæ.

Occurs from Pennsylvania westward.

D. truncatus, n. sp.

Rufo-piceous, moderately shining, surface sparsely clothed with very short hair. Front moderately, densely punctate. Thorax as wide as long, gradually arcuately narrowed from base to apex, margin very finely serrate, disc anteriorly, roughly granulate, posteriorly, feebly but densely muricate. Elytra with coarse, deep, closely placed punctures, arranged in moderately regular striæ, except near the scutellum, intervals not elevated, declivity abrupt, flat, densely punctate, acutely margined. Body beneath opaque, obsoletely punctate. Length .14 inch ; 3.5 mm.

The marginal ridge of the declivity encloses an exact semi-circle, while the face of the declivity is nearly vertical to the axis of the body.

Two mutilated specimens from California.

D. brevis, n. sp.

Cylindrical, robust, brownish, shining, sparsely hairy. Thorax as broad as long, slightly narrowed to the apex, base truncate. margin not serrate, disc anteriorly with short dentiform asperities arranged in four or five transverse series; behind these the thorax is densely and coarsely punctured, disc sub-carinate at middle posteriorly, and on each side of this a feeble depression. Elytra, cylindrical, obtusely declivous posteriorly, surface coarsely and deeply and moderately densely punctured. Body beneath piceous, legs paler. Length .12 inch; 3 mm.

This species differs from all the others by its eleven-jointed antennæ, the additional joint occurring among the small ones between the second and the club. Its form is also shorter, and more robust, resembling in this respect some of the species of *Xyleborus*. In this species we have the third instance in our fauna of the variation of the number of antennal joints within what must be considered generic limits.

Several specimens sent me by Dr. Summers from New Orleans.

Tribe **PSOINI.**

Head entirely free, eyes at least moderately prominent. Antennæ nine or ten-jointed, terminated by three-jointed club, which is a little shorter than the preceding portion. Thorax oval, sides not margined, surface not muricate. Tarsi slender, elongate, four-jointed in *Psoa*, five-jointed in *Polycaon*, the first joint being very small.

Two genera occur in our fauna.

Anterior coxæ separated, tibiæ serrulate........................**Polycaon.**
Anterior coxæ contiguous, tibiæ slender, simple....................**Psoa.**

With *Polycaon* I have united *Exopioides*, the ten-jointed antennæ being the only differential character. There are species belonging to the latter genus with the declivity margined, but not exactly as in the normal series of *Polycaon*. *Acrepis* does not differ essentially from *Psoa*, and another instance is thus presented of the analogy of the fauna of the western side of our own continent, with that of the western side of the eastern continent.

POLYCAON Lap.

This genus contains species of moderate size, the first black and slightly depressed, the others piceous or brownish and cylindrical.

The antennæ exhibit important differences. In *Stoutii* the fourth joint is rather elongate, and 4–8 slightly compressed, these taken together longer than the club. In the other species the third and fourth joints are of nearly equal size, and sub-moniliform, and taken together not longer, rarely as long as the club.

Exopioides (which is here suppressed) differs only in having one joint less in the funiculus.

The prosternum separates moderately widely the coxæ, and is slightly dilated behind in *Stoutii*, or not dilated in the others.

The elytral declivity presents two forms, that in which the tip is gradually declivous, or that in which the declivity is more or less flattened, and limited by an acute edge, thus far an equal number of species occurs in each.

The epistoma is rather deeply emarginate in *Stoutii*, in the other species truncate or broadly emarginate.

By an arrangement of the above characters our species may be tabulated in the following manner:

- Antennæ eleven-jointed.
  - Third joint of antennæ much smaller than the fourth, joints 3–8 together longer than the club.
    - Prosternum behind dilated (*Allæocnemis*).
      - Thorax punctured on the disc and shiny................**Stoutii** ♂.
      - Thorax granular and opaque..............................*ovicollis* ♀.
  - Third joint of antennæ equal to the fourth, joints 3–8 together shorter than the club. Prosternum not broader behind.
    - Declivity of elytra not acutely margined.
      - Thorax punctate at middle..........................**punctatus** ♂.
      - Thorax granulate....................................*pubescens* ♀.
    - Declivity of elytra acutely margined.
      - Elytra coarsely, densely and roughly punctured.
        - Marginal ridge of declivity short........................**exesus.**
        - Marginal ridge of declivity long......................**obliquus.**
      - Elytra sparsely and coarsely punctured, transversely plicate at the sides..**plicatus.**
- Antennæ 10-jointed. Joints 3 and 4 equal.
  - Joints 3–7 together not longer than the club. Elytra not margined at declivity...**confertus.**

P. Stoutii Lec. ♂. Proc. Acad., 1853, p. 233; *ovicollis* Lec. ♀. Pacif. R. R. Rep., 1857, p. 49.

This species is the largest in our fauna. The color is deep black. The elytra are gradually rounded at declivity without any elevated ridge at the sides. The two sexes appear so distinct that a separate mention will be made of each. Length .38–.76 ♀, .60–.84 ♂ inch; 10–19 mm. to 15–21 mm.

Male. Head large, equaling the thorax in size. surface rather coarsely granulate but not opaque; clypeus concave rather deeply emarginate at middle; mandibles stout and moderately prominent. Thorax moderately shining, disc punctured at middle, at sides and beneath granulate. Elytra shining, sparsely and rather finely punctulate.

Female. Head not as large as the thorax, surface opaque, rather coarsely granulate; clypeus flat, feebly emarginate at middle; mandibles not prominent. Thorax opaque, granulate over the entire surface. Elytra opaque, scabrous, sub-granulate near the base.

The head and thorax have erect black hairs sparsely placed, the elytra very finely pubescent. This latter is, however, rarely seen, as the hairs are very easily destroyed. I have never observed any sexual characters other than those mentioned above. The anterior femora appear to be a little stouter in the male, but this is not very evident. It has long been suspected by me that these were sexes of one species, so that in the

"Check List," p. 127, I ventured the suggestion which I now feel must be more positively stated.

Occurs in California and Oregon.

P. punctatus Lec. ♂. New Species 102; *pubescens* Lec. ♀. loc. cit.

Piceous brown, moderately shining, surface sparsely clothed with unequal, erect, yellowish hairs. Elytra regularly convex at the declivity, the latter without marginal ridge. Length .40♀-.48♂ inch; 10–12 mm.

Male. Head a little larger and with the mandibles a little more prominent. Thorax sub-granulate at the sides, punctured at middle. Elytra finely and rather sparsely punctate.

Female. Head and mandibles smaller than the male. Thorax granulate over the entire surface but not densely. Elytra more distinctly punctate.

The differences here are parallel with those noticed in the preceding species.

Occurs in the Peninsula of Lower California.

P. exesus Lec. Proc. Acad., 1858, p. 74.

Piceous, moderately shining, sparsely clothed with erect, yellowish pubescence. Head densely granulate, vertex with a smooth line at middle. Thorax moderately densely granulate. Elytra convex at the declivity, the latter margined around the apex, the two ridges and apical margin limiting a semicircular space; surface with very coarse and deep punctures which are very dense at the sides and posteriorly, at apex the punctures become obsolete and are replaced by granules. Length .56 inch; 14 mm.

The specimen before me is a female apparently, but has the sutural angle of the elytra slightly dentiform. This species differs from the next by its deeper and rougher sculpture and by the marginal ridge of the declivity short.

Occurs in the Peninsula of Lower California.

P. obliquus Lec. Trans. Am. Ent. Soc., 1874, p. 66.

Dark brown, feebly shining, sparsely pubescent. Head granulate. Thorax granulate at the sides, moderately, coarsely punctured on the middle of the disc. Elytra moderately, densely muricately punctured, declivity oblique, slightly flattened, sparsely granulate, much smoother at tip, and with a limiting ridge, the two sides and apex enclosing three-fourths of a circle. Length .48 inch; 12 mm.

I have two specimens before me, both females probably, which differ from the preceding species by their less rough sculpture, and the declivity flatter and more nearly surrounded by the acute margin.

Occurs in Texas.

P. plicatus Lec. loc. cit. p. 65.

Brownish, shining, very sparsely hairy. Head finely granulate. Thorax sparsely punctate. Elytra with a few coarse punctures sparsely placed near the base, and along the suture, sides slightly flattened, and with transverse plications; declivity oblique, flat, very finely and sparsely punctate, and limited by an elevated ridge, which with the apical margin includes rather more than three-fourths of a circle. Length .36–.40 inch; 9–10 mm.

This species is distinct from all the others by its elytral sculpture.

Occurs in Texas.

P. confertus Lec. New Species, 1866, p. 102; *incisa* Lec. (*Exopioides*) Trans. Am. Ent. Soc., 1868, p. 64.

Chestnut brown, feebly shining, sparsely pubescent. Head and thorax moderately densely granulate. Elytra moderately densely punctate, becoming granulate at the sides and apex, declivity oblique, not flattened nor margined. Length .30–.46 inch; 7.5–11.5 mm.

Male. Apices of elytra separately emarginate, and with a sutural and external angulation.

Female. Apices of elytra entire.

The suppression of *Exopioides* into *Polycaon* follows from the course adopted in *Sinoxylon* where species are recognized with ten-and nine-jointed antennæ. In all other respec's the two genera fully agree.

Occurs in California where it is said to depredate on grape vines.

PSOA Hbst.

Acrepis Lec. Ann. Lyc., V, p. 213.

Head free, labrum small, indistinct. Antennæ ten jointed, terminated by a loose, three-jointed club; first joint stout, obconical, second shorter, oval, 3–7 subequal, longer and more slender than the second, the fourth being a little longer than the others, eighth oboval, ninth shorter, tenth oval, a little longer than the ninth. Anterior coxæ very narrowly separated by a short prosternum. Tarsi slender, the first joint not distinct.

At the base of the first joint of the tarsus a faint trace exists of the point of union between the true first joint, and that which appears to be first, but which is really the same as the long second joint of *Polycaon*. There is quite a distinct onychium in our species, although Lacordaire says there is none in the species which were before him.

The genus *Acrepis* was founded on a specimen captured by Dr. LeConte, in California, and which was subsequently lost at sea with other types, while on the way to Europe for the examination of Lacordaire. In 1868 another species was found, but the specimen was not in the most desirable state for examination, consequently the best was made of the specimen before me and the genus retained as distinct. The material now at my command is all that could be desired, and indicates that *Acrepis* should be suppressed into *Psoa*.

Our species are two in number, of one of them we have yet no example, the only evidence of its existence being the description, and the memory which Dr. LeConte retains of his type. For the latter I can only reproduce his description.

P. maculata Lec. (*Acrepis*) Ann. Lyc., V, p. 213.

Piceous-æneous, shining, sparsely clothed with cinerous pubescence. Head and thorax globose, the latter narrower behind, truncate and margined, densely punctured. Elytra parallel cylindrical, not wider than the thorax, rugosely punctured, suture, margin and three spots on each white. Length .34 inch ; 8.5 mm.

The first spot is humeral, the second median, the third narrow, lunate and near the tip.

Notwithstanding the view expressed to me by Dr. LeConte, I suspect that this and the next species will prove to be one.

P. quadrisignata Horn, (*Acrepis*) Trans. Am. Ent: Soc., 1868, p. 135.

Æneous, shining, sparsely pubescent. Thorax not densely punctate. Elytra variable in color, surface moderately densely punctured and rugulose. Body beneath moderately densely punctulate, sparsely pubescent. Abdomen æneous at the sides, rufous at the middle, sparsely punctulate. Legs æneous. Length .22–.36 inch ; 5.5–9 mm.

Var. ——. Elytra blue with a small red humeral spot.

Var. quadrisignata Horn Elytra blue with a humeral and subapical red spot.

Var. ——. Elytra blue, lateral margin red, uniting the humeral and subapical spots, the spots also larger in size.

Var. ——. Similar to preceding, with the suture also red, and a small blue spot appears in the centre of the apical spot.

Var. ——. The red color still further extends, so that the elytra are red with three blue spots, one at basal third, one behind the middle, and one apical.

Occurs in Mariposa County, California.

Synopsis of the COLYDIIDÆ *of the United States.*

BY GEORGE H. HORN, M.D.

(*Read before the American Philosophical Society, April* 19, 1878.)

The first arrangement of the genera of this family is due to Erichson, who created it, associating genera whose aggregate possesses very little homogeneity, no less in form and general external appearance than in more important structural characters. The family appears to be composed of a certain number of genera which form natural groups or tribes, as the *Synchitini* and *Colydiini*, around which are arranged other tribes composed of genera with feeble alliances among themselves and which seem to be like *Cupes* and *Rhysodes*, either relics of pre-existing faunæ or indifferentiated in characters so that whatever position may be assigned them in an attempted linear arrangement of genera they will be equally out of place.

There is very little to be added to the generalities of the family beyond what Lacordaire and Duval have given, several characters of limited occurrence remain to be noticed. The position of the antennæ varies in the different genera. In *Corticus*, *Rhagodera* and their allies the antennæ are for this family very distant from the eyes, and under a rather wide frontal margin. In the following tribes the antennæ gradually approach the eyes so as to be nearly in contact with them, the frontal margin disappears, finally the sides of the front are acutely notched and the antennæ become frontal in their insertion. It seems not to have been observed that the anterior coxæ are open behind in a large number of genera; this seems to me a character of considerable importance and considerable use has been made of it in the following pages. The ventral segments are said to be fixed and immovable, except the last two; this also needs correction for a large number of genera.

The anterior and posterior coxæ are always small and globular, the former in several genera contiguous, the latter always separated although at times narrowly. The posterior coxæ vary from transverse to oval or round, and are *never* contiguous although at times narrowly separated, often very widely distant.

Erichson and those who follow him use the supposed greater length of the first ventral segment as a means of separating the *Colydiides* from the *Synchitides*. Very little observation will convince any one that this character has in the first place no such value and it moreover does not exist where it should, and I have been greatly surprised at finding the actual condition of the posterior coxæ and first ventral segment of *Corticus tauricus*, which should by Erichson's system be a *Bothrideride*.

In studying *Discoloma Fryi* and *Hyberis* n. sp.* I noticed a structure of the under surface of the body which is entirely at variance with the present family and rather anomalous among Coleoptera. In all the genera of COLYDIIDÆ the posterior coxæ are closed externally in part by the metasternal side pieces, sometimes the latter are curved inwards at the posterior end to meet the coxæ, but in the two genera above mentioned the posterior coxæ are exceptionally small and their cavities are excavated in the posterior edge of the metasternum and anterior edge of the first ventral segment, so that the coxæ are completely surrounded and the metasternal side pieces are distant from the outer edge of the coxæ, the suture in *Discoloma* being obliterated. This structure with the three-jointed tarsi mark these two genera as members of another family which may be called DISCOLOMIDÆ.

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* The *Hyberis* here mentioned is one given by Mr. Fry to Dr. LeConte labeled Cape of Good Hope. It is a black opaque species, of the general form of a *Coccinella*, surface roughly punctured and sparsely clothed with grayish pubescence, the elytral margin with small spots of black pubescence. The thorax has on each side an arcuate elevated line parallel with but distant from the margin. The abdomen is somewhat injured but there are five distinct segments; all are distinctly movable and there appears to be a *sixth* ventral segment pushed by some accident within the abdomen. To this I would call the attention of those possessing good specimens.

Mychocerus and *Myrmidius* must also form a distinct family following the example of Duval.

The arrangement followed in the present paper, although substantially that of Erichson, is based on other characters which appear to me more natural and constant. I have added a new tribe, *Rhagoderini*, to contain those genera without retractile antennæ, and also *Deretaphrini* for those genera with the anterior coxæ contiguous or very nearly so. The tribes thus become increased to seven and are distinguished as follows:

Antennæ perfoliate, not retractile, distant at base from the eyes.......... **Rhagoderini.**

Antennæ capitate, retractile, arising close to the eyes.
  Last joint of palpi not acicular.
    Anterior coxæ slightly separated. Head horizontal.
      First joint of tarsi short.............................. **Synchitini.**
      First joint of tarsi longer than the second .... **Colydiini.**
    Anterior coxæ contiguous or very nearly so. Head deflexed......... **Deretaphrini.**
    Anterior coxæ distant.
      Antennæ arising under a frontal margin. First ventral segment not elongate. Trochanters free .... **Pycnomerini.**
      Antennæ free at base. First ventral elongate. Trochanters closely connate with the femora........................ **Bothriderini.**
  Last joint of palpi acicular.
    First ventral elongate. Antennæ free at base............ **Cerylonini.**

Tribe I. RHAGODERINI.

Antennæ perfoliate, inserted under the frontal margin at a distance from the eyes, not capitate nor retractile. Anterior coxæ small, rounded, moderately separated by the prosternum, which is more elevated than the coxæ, and slightly dilated behind them. Middle coxæ more distant than the anterior. Posterior coxæ oval, small, variably distant, their cavities partially closed externally by the metasternal side pieces which are narrow. Tarsi short, the first three joints not longer than the fourth Abdominal segments gradually decreasing in length, the fourth, however, shorter than the fifth. Tibiæ without terminal spurs.

In the above characters a certain number of genera agree, important differences, however, are found, which, with the increase of the number of the genera, will warrant the division of the tribe into several. First in importance is the structure of the anterior coxæ, which are very plainly open behind in *Rhagodera* and *Corticus*, and closed in *Anchomma*. The eyes exhibit the next important difference. In the two genera first mentioned, the eyes are round, moderately prominent, coarsely granulated, and in *Anchomma* small, not prominent, and completely divided by the sides of the head.

These characters seem to indicate two sub-tribes.

Anterior coxæ open behind. Eyes entire........sub-tribe RHAGODERINI.
  Head narrowed behind, forming a distinct neck............**Rhagodera.**
Anterior coxæ closed behind. Eyes divided......sub-tribe ANCHOMMINI.
  Head not narrowed behind.............................**Anchomma.**

The latter genus appears not to have any allied form yet described. *Rhagodera* is plainly akin to *Corticus*, and probably *Sarrotrium* and *Diodesma*, which I have not examined in nature. In *Corticus* the head is not narrowed behind into a neck, and the posterior coxæ are so placed that even the most poetic imagination cannot call them contiguous, they are really distant, and this one fact goes far in exhibiting the entire absence of accuracy and fact in the characters used by Erichson in defining his tribes.

The genera representing this tribe in our fauna are from the Pacific Region.

RHAGODERA Erichs.

Antennæ inserted under the margin of the front, not retractile, 11-jointed, moderately short, slightly flattened, joints perfoliate, sparsely clothed with short, scale-like hairs; first joint more slender, and not longer than second, third joint nearly as long as the three following together; joints 4–10 transverse, very gradually broader, eleventh narrower than the tenth and oval acuminate at tip. Head horizontal, as broad as long, sides of front dilated over the insertion of the antennæ, suddenly narrowed behind. Eyes entire, coarsely granulated, moderately prominent. Mentum transverse, gula deeply emarginate, its angles acutely prolonged to the front, it sides forming a distinct ridge beneath the eyes. Maxillæ visible beneath. Labrum short, transverse, almost entirely concealed by the epistoma, the latter feebly emarginate at middle. Thorax as wide as the elytra, apex emarginate, base arcuate at middle, and acutely sinuate on each side, side margin acute, serrate. Elytra oblong, humeral angles moderately prominent, disc acutely carinate. Scutellum small. Anterior coxæ small, moderately distant, prosternum more elevated than the coxæ. Posterior coxæ narrowly separated, intercoxal process moderately long, obtusely rounded at tip. Abdominal segments 1–4 gradually shorter, fifth slightly longer than the fourth. Tibiæ slender, but gradually broader to tip. Apex fimbriate with short spinules without terminal spurs. Tarsi short, clothed beneath with short bristles, 1–3 gradually decreasing in length, fourth nearly as long as the preceding together, and with rather stout claws.

I have already (Proc. Am. Ent. Soc. 1867, p. 293), called attention to a certain amount of confusion between *Usechus* and *Rhagodera.* The history of the two genera is in short as follows: Eschscholtz used the name *Rhagodera tuberculata* for an insect in the Dejean collection, and the name was published in the third edition of the Catalogue without description. Mannerheim, in 1843, published in few words, a description as that of *Rhagodera tuberculata.* This is the first publication, and has priority. In 1845, Motschulsky described and figured *Usechus lacerta.* This is also a correct description and figure. While in London, in 1874, I saw that part of Dejean's collection containing the original of the name *Rhagodera*, and found it to be the same as *Usechus lacerta.* Motschulsky probably saw this same specimen in Mr. E. W. Janson's possession, and was thereby induced to pronounce his insect synonymous.

Rhagodera and *Usechus* must be allowed to stand in the sense in which they are at present used, and the name on the Dejean specimen go for naught.

Two species are known to me.

Thorax arcuate on the sides, hind angles rectangular........**tuberculata.**
Thorax strongly sinuate, hind angles acute, prominent...........**costata.**

Rh. tuberculata Mann. Bull. Mosc. 1843, II, p. 300; Horn, Proc. Am. Ent. Soc. 1867, p. 293.

Oblong depressed, brownish, sub-opaque. Head sparsely granulate, each granule with a small scale-like hair. Thorax broader than long, sides regularly arcuate, and gradually narrowed to base, margin serrate, and with short, scale-like hairs, hind angles rectangular, not prominent, base arcuate at middle, on each side serrate within the angles; disc strongly bicostate, costæ arcuate, and convergent at apex and base, surface very sparsely granulate, and with scale-like hairs. Elytra oblong, humeri rectangular, suture, margin and the discal costæ acutely elevated, intervals with two rows of large cribriform punctures. Body beneath sparsely granulate, and with few scales. Legs sparsely clothed with short, scale-like hairs. Length .22–.28 inch; 5.5–7 mm.

In well preserved clean specimens the summits of the elytral costæ have erect scales rather distantly placed, and between these are shorter capitate scales.

Occurs usually under bark from Alaska to San Diego and Arizona, and not common.

Rh. costata Horn, Proc. Am. Ent. Soc. 1867, p. 293.

This species resembles in all essential characters the preceding and differs in having the thorax rather deeply sinuate posteriorly, the hind angles acute and prominent. Length .34 inch; 8.5 mm.

In both species the frontal margin is acutely serrate.

Occurred at Gila Bend Station, Arizona. The measurement previously given by me is a little too great.

ANCHOMMA Lec.

Antennæ inserted under the margin of the front, eleven-jointed, not retractile, moderately stout, slightly flattened, joints perfoliate, sparsely clothed with scale-like hairs; first joint short, obconical, second transverse, third as long as the next two together, four to nine transverse, equal, tenth somewhat larger, eleventh smaller and narrower than the tenth, truncate at tip. Head horizontal, oblong, sides parallel at middle, gradually narrowed at apical third, posteriorly rather suddenly narrowed. Eyes small, flat, divided by the side of the head, upper portion linear, lower portion very small. Mentum oval, supported by a distinct peduncle; sides of genæ triangularly prolonged in front and continuing posteriorly in a ridge. Maxillæ not concealed, palpi moderately long, last joint longer than the preceding, truncate at tip. Labrum not visible beyond the clypeus. Anterior coxæ small, moderately distant, less prominent than the prosternum. Posterior coxæ separated by a quadrangular process arcuate in front. Legs slender, tibiæ fimbriate at tip with short spinulose hairs, without spurs. Tarsi short, sparsely hairy beneath, first three joints gradually decreasing in length, fourth joint as long as the first three and with stout claws. Abdomen with first three segments gradually shorter, fourth very short, fifth as long as third.

A. costatum Lec. Proc. Acad. 1858, p. 63; Journ. 1858, pl. 1, fig. 18.

Form elongate, color variable, piceous to pale brown, opaque. Head granulate, front finely carinate, sparsely clothed with yellowish scale-like hairs. Thorax very little longer than wide, apex and base equal, sides very feebly arcuate, margin acute, disc with three parallel costæ near the middle the central finer, surface as in the head. Elytra with the suture moderately elevated, and with three discal costæ and margin acutely prominent, intervals biseriately coarsely punctured. Body beneath coarsely but sparsely punctate, sparsely clothed with scale-like hairs. Length .16 inch; 4 mm.

Occurs from San Diego to Owen's Valley, California, and rather abundant in the latter locality.

Tribe II. SYNCHITINI.

Antennæ capitate, retractile, inserted under the frontal margin a short distance in front of the eyes. Head horizontal, eyes usually round, moderately prominent, entire, rarely (*Phlœonemus*) emarginate by the sides of the front. Anterior coxæ small, rounded, narrowly separated, usually a little more prominent than the sternum between them. Middle coxæ moderately distant. Posterior coxæ transverse, attaining the margin of the body, separated by a triangular abdominal process. Metasternal side pieces narrow, rarely (*Eudesma*) concealed by the elytra. Abdominal segments decreasing gradually in length, and in *Cicones* distinctly mobile. Tarsi short, first three joints subequal, together not longer than the fourth.

The genera of this tribe in our fauna are represented by species the sculpture of which is more or less coarse, either costate or granulate, opaque and pubescent.

Here also we have differences in the structure of the anterior coxal cavities, all excepting two have these open behind. The other characters in which differences occur are those of generic value merely. The tribe as here defined is homogeneous and scarcely merits further division.

The genera are:

Anterior coxal cavities open behind.
  Antennæ 10-jointed, club solid.
    Head without antennal grooves .... **Synchita.**
    Head with distinct grooves .... **Cicones.**
  Antennæ 11-jointed, club 2-jointed.
    Eyes free rounded.
      Head without antennal grooves .... **Ditoma.**
      Head with distinct antennal grooves.
        Tibiæ with distinct terminal spurs .... **Eudesma.**
        Tibiæ without terminal spurs .... **Endophlœus.**
    Eyes emarginate by the sides of the front.
      Antennal grooves distinct .... **Phlœonemus.**
Anterior coxal cavities closed behind.
  Antennæ with a 2-jointed club. No tibial spurs .... **Coxelus.**
  Antennæ with a 3-jointed club. Small tibial spurs .... **Lasconotus.**

SYNCHITA Hellw.

Antennæ 10-jointed, terminated by an abruptly larger joint which is glabrous at base, pubescent at tip. Head beneath without antennal grooves. Tarsi stout, first three joints very short, but little longer than half the fourth, clothed beneath with short pubescence. Tibiæ slender with minute terminal spurs.

Our species are as follows :

Elytra finely costate.
  Thorax with an elevated line on each side.................... **laticollis.**
  Thorax without elevated lines.............................. **variegata.**
Elytra uniform, not costate.
  Elytra variegated with paler markings........................ **parvula.**
  Elytra unicolorous.
    Thorax finely granulate, margin finely serrulate. A sub-apical impressed line.................................... **fuliginosa.**
    Thorax coarsely granulate, margin coarsely serrate. Without sub-apical impressed line................................ **granulata.**

S. laticollis Lec. New Species, 1863, p. 66; Proc. Acad. 1866, p. 379.

Oblong, sub-depressed, piceous, opaque, humeri and a spot near the apex of the elytra rufous, body beneath and legs ferruginous. Thorax wider than long, slightly narrowed at base, surface granulate and with an elevated line on each side and a feeble impression at middle, margin obsoletely serrulate. Elytra with suture, three discal costæ and margins sub-acutely elevated, intervals biseriately granulate. Length .08 inch ; 2 mm.

Occurs from New York to North Carolina, not common.

S. variegata Lec. Proc. Acad. 1858, p. 63.

Oblong elongate, moderately depressed, piceous, opaque, elytra ornate with pale markings. Thorax wider than long, margin very finely serrulate, narrower at apex than base, surface granulate. Elytra with suture, four discal costæ and margin acutely elevated, intervals biseriately coarsely and deeply punctured. Length .08-.10 inch ; 2-2.5 mm.

Occurs at Fort Yuma, Cal.

These two species resemble each other in being costate but differ in every other particular. The thorax is narrowed to base in *laticollis*, wider at base *variegata*, elytra tricostate in the former and quadricostate in the latter, with intervals granulate in one and deeply punctured in the other.

S. parvula Guerin, Icon. Regn. Ins. p. 189.

Oblong, sub-depressed, piceous, opaque, elytra ornate with whitish spaces. Thorax wider than long, sides feebly arcuate, margin finely serrulate, base slightly wider than apex, surface granulate. Elytra with striæ of moderate punctures, rather closely placed, intervals granulate. Length .08-.10 inch ; 2-2.5 mm.

Occurs in the Middle States, rather rare.

S. fuliginosa Mels. Proc. Acad. II, p. 111 ; *nigripennis* Lec. New Species, 1863, p. 67.

Oblong, parallel, sub-depressed, opaque. Thorax wider than long, sides scarcely arcuate, margin very finely serrulate, base and apex equal, disc rather finely granulate, anteriorly a finely impressed sub-apical line. Elytra with striæ of moderately deep punctures, intervals slightly convex and sub-granulate. Body beneath, antennæ and legs ferruginous. Length .10 inch; 2.5 mm.

Occurs in the Middle States region and Georgia.

S. granulata Say, Journ. Acad. V, p. 266.

Oblong, parallel, moderately convex, piceous, sub-opaque. Antennæ with the third joint as long as the three following together. Thorax wider than long, sides very feebly arcuate, margin serrulate, base slightly narrower than apex, disc coarsely granulate. Elytra coarsely granulate with feeble traces of striæ between the rows of granulations. Legs ferruginous. Length .16 inch; 4 mm.

This species besides being the largest and most coarsely granulate, has the third joint of the antennæ very long while in all the other species it is but little longer than the following.

This species is widely diffused, occurring from Missouri to Pennsylvania and Georgia.

The vestiture of the surface in the first four species consists in recumbent pale, sparsely placed hairs on the head and thorax, the costæ of the elytra and the intervals have short, erect, pale setæ. In *granulata* there are no hairs on the head and thorax, while the elytra have short hairs sparsely placed which become somewhat longer on the declivity.

CICONES Curtis.

Antennæ 10-jointed, terminated by a club of one joint, glabrous at base, pubescent at tip, received in distinct and deep grooves which follow the inferior margin of the eye. Abdominal segments very feebly emarginate, apical angles very slightly prolonged.

This genus is closely allied to Synchita and differs in the above characters only.

C. marginalis Mels. Proc. Acad. II, p. 112.

Oblong-oval, piceous, opaque, depressed. Head finely granulate, sparsely pubescent, epistoma feebly emarginate. Thorax more than twice as wide as long, sides moderately arcuate, margin explanate and finely serrulate, disc granulate and sparsely pubescent. Elytra opaque, obsoletely striato-punctate, intervals flat irregularly biseriately punctate, each puncture bearing a semi-erect, short, clavate hair; surface opaque, each elytron with four or five indistinct rufous spots. Body beneath and legs dark ferruginous. Length .10–.12 inch; 2.5–3 mm.

Occurs from Pennsylvania to Kansas.

C. lineaticollis, n. sp.

Oblong-oval, piceous, opaque, depressed. Head finely granulate, sparsely pubescent. Thorax nearly twice as wide as long, sides feebly arcuate, hind angles broadly rounded, margin explanate, finely serrulate, disc at middle moderately convex, and at sides with three finely elevated lines, surface opaque, finely granulate. Elytra finely striate, striæ rather coarsely punctured, each alternate interval more convex especially at base and indistinctly granulate. Body beneath and legs dark ferruginous, sub-opaque. Length .10 inch; 2.5 mm.

This species is smaller, more elongate and depressed than the preceding and differs especially in the three fine lines on each side of the thorax and the alternation of the elytral intervals.

The specimen before me is badly rubbed and I cannot describe its vestiture.

Two specimens; South Carolina and Florida.

DITOMA Illig.

Antennæ eleven-jointed, inserted under the margin of the front, last two joints forming an abrupt club. Antennal grooves wanting. Eyes moderately large and convex, coarsely granulated, nearly entirely free. Tibiæ slender, feebly broader at tip and with minute terminal spurs. Intercoxal process triangular, acute.

The remaining characters are fully exposed by Lacordaire. This author speaks of the hind margins of the ventral segments being emarginate, this certainly does not occur in any species known to me. The antennæ in one species (*sulcata*) depart from the usual form in a rather suggestive manner, the ninth joint being much wider than the eighth, so that there is a feeble attempt at a triarticulate club. I follow the example of Mr. Crotch (Check List) in including *Eulachus carinatus* Lec. in *Ditoma*, notwithstanding its semi-cylindrical form. That it may fairly represent *Eulachus* I have very little doubt, but the genus seems very much out of place where Erichson left it.

Our species are as follows:

Antennæ with ninth joint not wider than the eighth.
  Form semi-cylindrical, thorax longer than wide .... **carinata.**
  Form depressed, thorax wider than long.
    Elytra piceous black, three or four rufous spots on each. . **quadriguttata.**
    Elytra piceous, two rufous spots on each .... **ornata.**
Antennæ with ninth joint much wider than the eighth.
  Form depressed, thorax wider than long, color rufous.......... **sulcata.**

As thus arranged the species show a very natural transition from *Eudesma* to *Lasconotus*, *carinata* having the semicylindrical form of the first, while *sulcata* by its antennæ makes a feeble approach to the second.

D. carinata Lec. (*Eulachus*) New Species, 1863, p. 68.

Elongate, semi-cylindrical, black, opaque. Head granulated, opaque. Thorax longer than wide, slightly narrower at base, apex feebly emarginate, angles obtusely rectangular, sides straight, margin obsoletely crenulate, base arcuate at middle, hind angles rectangular, disc convex, and with four moderately elevated carinæ, intervals granulate. Elytra parallel, not wider than the thorax, four discal carinæ moderately, margin more acutely prominent, intervals flat, biseriately, coarsely punctate and rugulose. Body beneath scabrous. Legs and antennæ rufous. Length .12 inch; 3 mm.

The elevated costæ are finely punctured at their summits, and bear short yellowish hairs. This species reproduces closely the figure given by Lacordaire (Atlas pl. 20, fig. 2) and the two may be identical, but comparison will be necessary. I do not find the first ventral segment sufficiently long to place this insect in the *Colydiini* (sec. Er.), and from the study of our genera it seems to me that Erichson had rather vague ideas as to what constituted a long segment, and that this term was used very empirically without any intention of its being literally interpreted.

Occurs in Georgia and Florida.

D. quadriguttata Say, Journ. Acad. V, p. 266; *Zimmermanni* Guer. Ic. Regn. Ins. p. 194.

Oblong elongate, pitchy black, opaque. Head granulate, sparsely pubescent. Thorax broader than long, slightly narrower at base, apex feebly emarginate, sides nearly straight, margin obsoletely crenulate, disc with four moderately elevated carinæ, each curved inwards in front, the two median ones united, forming an arch, intervals granulate, sparsely pubescent. Elytra slightly wider than the thorax, four discal costæ and margin acutely elevated, intervals biseriately, coarsely punctured; color black, each elytron with three or four rufous spots. Body beneath pitchy black, legs brownish. Abdomen with coarse punctures longitudinally sub-confluent. Length .10-.12 inch; 2.5-3 mm.

The summits of the elytral costæ are fringed with short, yellowish pubescence.

Occurs from the Middle States to Illinois and Texas.

D. ornata Lec. Proc. Acad. 1858, p. 63.

This species resembles the preceding, but has a relatively narrower thorax, intervals between the elytral costæ more finely punctured, and with two rufous spots on each, one oblique at the humeri, another oval behind the middle. Length .12 inch; 3 mm.

The differences although feeble are constant, and the facies of the two species is sufficiently marked to retain them as distinct.

Occurs under bark in south-eastern California and Arizona.

D. sulcata Lec. Proc. Acad. 1858, p. 63.

Resembles *quadriguttata* in form, pale brownish, opaque. Elytral intervals with coarse punctures biseriately arranged. but not very closely placed. Antennæ with ninth joint one-half wider than the eighth. Length .12 inch; 3 mm.

The principal difference between this and the preceding species are the uniform color, and the structure of the antennæ.

Occurs under bark with *ornata*.

EUDESMA Lec.

Antennæ received in repose in oblique grooves, 11-jointed, last two forming an abrupt mass, first two joints shorter, the second rather longer than the first, third slightly longer than the fourth, 4–9 sub-equal, tenth abruptly larger, semi-circular in outline, last joint narrower, oval, pubescent at tip. Head broader than long, clypeus truncate. Labrum almost entirely retracted. Eyes entire, rounded, moderately convex. Mentum transverse. slightly rounded in front. Last joint of maxillary palpi, longer than the two preceding, slightly flattened, truncate at tip. Antennal groove deep, oblique. Thorax quadrate, lobed at middle in front. Scutellum small. round. Elytra elongate, parallel, costate. Posterior coxæ transverse, intercoxal process narrow, acute at tip. Metasternal side pieces almost entirely concealed by the elytra. Abdominal segments gradually decreasing in length, fifth a little longer than the fourth, posterior margin straight. Tibiæ slender, not spinulose externally, and with minute terminal spurs. Tarsi short, first three joints nearly equal, together shorter than the fourth, beneath sparsely hairy.

I find no genus with which this may be compared, excepting *Ditoma*. *Phormesa* Pasc. differs from *Ditoma* in the same manner that this does, but the form of the body is somewhat peltiform.

E. undulata Mels. (*Bitoma*) Proc. Acad. II, p. 110; Lec. New Species, 1863, p. 66.

Elongate, sub-cylindrical, piceous, opaque. Head opaque, granulate, sparsely pubescent. Thorax quadrate, slightly narrowed posteriorly, apex broadly prolonged at middle, sinuate on each side, angles rectangular, sides nearly straight, margin serrulate and narrow, base arcuate at middle, hind angles rectangular, disc convex, with two obtuse costæ at middle, and two shorter between them in front; surface moderately, densely granulate and opaque. Elytra slightly wider than the thorax, parallel, apical fourth gradually narrowed, with three discal costæ and margin acutely elevated, intervals biseriately quadrate punctate, color piceous, base, narrow fascia at middle and apical third rufous, these with pale pubescence. Body beneath and legs rufous, abdomen granulato-punctate. Prothorax beneath obliquely strigose at the hind angles. Length .20 inch; 5 mm.

I have seen Melsheimer's type only, collected in Pennsylvania.

ENDOPHLŒUS Erichs.

Antennæ 11-jointed, terminated by a two-jointed club, inserted moderately, distantly from the eyes, received in repose in oblique, antennal grooves. Head half retracted within the thorax, sides of front elevated and slightly prolonged backwards over the eyes. Eyes free, round, moderately prominent.

Thorax with explanate and serrate margins, apex slightly prolonged at middle over the head, disc costate. Elytra parallel, obtusely rounded at tip. Anterior coxæ, moderately separated, the cavities open behind. Posterior coxæ separated by a triangular acute process. Abdomen with first segment slightly longer than the others, 2–3–4 gradually shorter, fifth slightly longer than the fourth. Tibiæ slender, not spinulose externally, and without terminal spurs. Tarsi short, first three joints sub-equal, together not longer than the fourth.

E. nosodermoides, n. sp.

Oblong-elongate, brownish, opaque, surface coated with a brownish indument and apparently scaly. Head opaque, granulate. Thorax broader than long, sides explanate and serrulate, feebly arcuate and gradually narrowed posteriorly, hind angles slightly prominent, base lobed at middle, anterior angles slightly prolonged forward, apex at middle prolonged over the head; disc on each side costate, costæ sinuous; surface granular, opaque. Elytra not wider than the thorax, base feebly emarginate at middle, humeri obtuse, sides parallel, on each elytron four costæ, the inner sinuous, parallel for a short distance at middle terminating at the declivity in a tubercle beneath which is another tubercle, second costa very short, third costa beginning at the humerus extends to three-fourths, between its extremity and the first costa is a tubercle, fourth costa sub-marginal and longer than the others, intervals tuberculate and opaque. Body beneath opaque, densely and rather finely granular, prothorax beneath coarsely granular. Length .30 inch; 7.5 mm.

This species reproduces in miniature the appearance of *Phellopsis obcordata.*

One specimen given me by Mr. Jas. Behrens, collected at Mount Shasta, California.

PHLŒONEMUS Erichs.

Antennæ eleven-jointed, last two forming an abrupt club, which is glabrous. Head broad, clypeus broadly rounded in front, sides dilated. and extending to the middle of the eyes, beneath with deep, slightly oblique antennal grooves. Eyes coarsely granulated, moderately convex. Mentum transversely quadrate, maxillary palpi with terminal joint cylindrical-compressed, longer than the preceding together and truncate at tip. Labrum retracted. Abdominal segments gradually decreasing in length, their posterior margins straight. Intercoxal process narrower in front and rounded at tip. Anterior tibiæ slightly dilated at tip, the outer margin not fimbriate. Tibiæ with distinct terminal spurs. Tarsi rather short, first three joints short and nearly equal, together shorter than the fourth. sparsely hairy beneath. Form oblong-elongate moderately convex.

Ph. catenulatus, n. sp.

Oblong-elongate, reddish-brown, base, apex and suture of elytra somewhat paler. Head granulate, sub-opaque. Thorax one-half broader than long, apex emarginate, angles obtusely prominent in front, sides feebly arcuate in front, then straight and nearly parallel, margin slightly explanate, obsoletely crenulate, base feebly arcuate, hind angles rectangular. disc moderately convex, moderately densely granulate. surface with feeble elevated anastomosing lines. Elytra oblong, parallel, base not wider than the thorax, humeri obtuse, a sub-sutural and four discal costæ, and lateral margin acutely prominent, intervals biseriately catenulate. Body beneath paler than above, rugulose. Length .18 inch; 4.5 mm.

One specimen, collected by myself at Fort Yuma, California.

This genus was indicated by Erichson in a few words without describing the typical species. The antennæ have the first two joints stouter, the second shorter than the first; third joint slightly longer than the fourth; 4–9 very gradually increasing in length and width; 10 abruptly broader emarginate at tip, 11 transversely oval, narrower than the tenth and pubescent at tip.

COXELUS Latr.

Antennæ eleven-jointed, last two joints forming a sudden club. Eyes free. Head with antennal grooves beneath the eyes. Tibiæ slender without terminal spurs. Our Species are winged.

C. guttulatus Lec. New Species, 1863, p. 65.

Oblong-oval, blackish, opaque, moderately convex. Head granulate, sparsely pubescent. Thorax twice as wide as long, apex deeply emarginate, angles prominent in front, sides broadly arcuate, margin explanate and serrulate, hind angles obtuse, base broadly arcuate at middle on each side, feebly sinuate, surface coarsely granulate, sparsely pubescent. Elytra with rather irregular rows of moderately coarse granules, surface sparsely pubescent, each elytron with spots of more dense pubescence forming a sinuous band near the middle and another behind it. Body beneath granulate, opaque. Length .18 inch; 4.5 mm.

This species occurs rather abundantly in the Middle States.

The margin of thorax is equally explanate at apex and base. The third joint of the antennæ is very nearly as long as the two following together. The abdomen is rather roughly granulato-punctate.

C. pacificus, n. sp.

Resembles the preceding in form and color but is relatively more elongate and differs besides as follows:

Thorax shorter, more transverse, margin widely explanate in front, becoming gradually less so posteriorly so that the thorax appears to become narrow behind. Abdomen coarsely but not densely punctured. Antennæ with third joint scarcely longer than the fourth, the latter not longer than the fifth. Length .18 inch; 4.5 mm.

Occurs not uncommonly at Vancouver.

LASCONOTUS Erichs.

Antennæ eleven-jointed, terminated by a three-jointed club, without antennal groove, first two joints stout, the first a little longer than the second, third slightly longer than the fourth, three to eight sub-equal, ob conical, last three forming an abrupt club. Head broader than long. Clypeus feebly emarginate in front, at sides broadly arcuate and extending posteriorly, forming a well-defined supraorbital ridge, in one species partially concealing the eyes from above. Eyes round, rather finely granulated, moderately prominent. Thorax quadrate, quadricostate. Scutellum small. Elytra parallel, costate. Abdominal segments gradually shorter, fifth slightly longer than the fourth, intercoxal process narrow, acute. Posterior coxæ transverse. Tibiæ slightly wider toward the tips, the anterior with two spinules at the outer angle, all with small terminal spurs. Tarsi as in *Ditoma*.

This genus was founded by Erichson on an undescribed species, and but few words of diagnosis given. Its characters are, however, perfectly valid, and one, the partial concealment of the eyes, is as remarked by Mr. Pascoe (Journal of Entomology, II, p. 33) a very unusual occurrence, the sides of the clypeus either terminating in front of the eye or partially dividing it. It should, however, be stated that while this structure is well marked in one species, it becomes gradually feebler so that there is merely a supraorbital ridge in all the others. These seem to me identical with Mr. Pascoe's genus *Illestus*.

Our species may be separated as follows:

Elytra equally costate over the entire surface.
  Thorax costate or with feebly elevated sinuous lines.
    Thorax wider than long.
      Disc of thorax costate. Eyes partially concealed.........**complex.**
      Disc with sinuous lines indicated by pubescence...........**borealis.**
    Thorax longer than wide, disc with sinuous lines............**linearis.**
  Thorax vaguely longitudinally concave.
    Thorax longer than wide...................................**simplex.**
    Thorax as wide or wider than long...................**referendarius.**
Elytra broadly longitudinally channeled, the fifth interval being strongly elevated and the first and third not so.......................**pusillus.**

L. complex Lec. Proc. Acad., 1858, p. 282.

Oblong-elongate, blackish, opaque. Head slightly concave, an obsolete tubercle on the vertex, surface granulate. Thorax quadrate, slightly wider than long, apex trisinuate, sides feebly undulate, margin obsoletely crenulate, base arcuate at middle, hind angles rectangular, disc quadricostate, median costæ approximate in front, then arcuate outwardly and converging at their apices, between which are two smaller costæ, outer costæ slightly undulated, intervals granulated. Elytra slightly wider than the thorax, each with four discal costæ and the margin acutely elevated, intervals biseriately punctate. Body beneath opaque, abdomen punctate, scabrous. Legs ferruginous. Length .16 inch; 4 mm.

Occurs from Punto de los Reyes, California, to Vancouver.

L. borealis, n. sp.

Elongate, piceous, elytra brownish, sub-opaque, sparsely pubescent. Head densely punctured, sparsely pubescent Thorax slightly broader than long, and a little narrower at base, surface finely granulate and with sinuous feebly elevated lines. Elytra slightly wider than the thorax, disc sub-depressed, each with four costæ and the margin acutely elevated, intervals biseriately quadrately punctured. Body beneath opaque, coarsely and densely punctured. Length .12 inch; 3 mm.

This species is closely allied to *linearis*, but is broader and more depressed and with a wider thorax, the sculpture of which is similar in the two species.

One specimen, Marquette, Michigan. Dr. Schwarz.

L. linearis Crotch. Trans. Am. Ent. Soc. 1874, p. 75.

Elongate, moderately convex, pitchy black, opaque, sparsely clothed with yellowish hair. Head granulate. Thorax longer than wide, slightly narrowed toward the base, sides straight, margin crenulate, hind angles distinct, disc with three shallow foveæ, one larger anterior, two smaller at base, feebly separated by obtuse elevations, with a row of yellowish hairs on their summits, surface opaque, punctato-granulate. Elytra black, opaque, base narrowly and small sub-apical spot rufous, parallel, very little wider than the thorax, and with four discal costæ and margin feebly elevated, intervals biseriately coarsely punctate. Body beneath piceous, surface moderately densely punctate. Legs paler. Length .10–.12 inch ; 2.5–3 mm.

The sculpture of the thorax of this species is nearly that described in another manner by Mr. Pascoe for *I. terrenus.*

Occurs under bark of trees at Santa Inez, California.

L. simplex Lec. Proc. Acad. 1866, p. 398.

Elongate, sub-cylindrical, brownish, opaque, sparsely clothed with yellowish pubescence. Head punctate, opaque. Thorax longer than wide, slightly narrowed posteriorly, sides straight, hind angles obtuse, margin simple, apical margin slightly thickened at middle, disc moderately convex, a feeble median impression, surface rather coarsely punctured. Elytra slightly wider than the thorax, suture, four discal costæ and margin subacutely elevated, intervals biseriately coarsely punctured. Body beneath moderately densely punctate, legs rufous. Length .10 inch ; 2.5 mm.

This species is the smallest in our fauna, and is known by the very feeble median impression of the thorax. The punctures of the elytral intervals are quite large and crowd each other so as to appear sub-confluent transversely. The prosternum between the coxæ is very narrow.

One specimen; Cape San Lucas, Lower California.

L. referendarius Zimm. Trans. Am. Ent. Soc. 1869, p. 254.

Elongate, sub-depressed, piceous, opaque, sparsely pubescent. Head punctured, with a vague impression on each side separated by an obtuse elevation. Thorax longer than wide, slightly narrowed behind, sides nearly straight, margin simple, apical margin with thickened edge, hind angles obtuse, disc vaguely longitudinally impressed and with traces of two fine carinæ visible only at the apex and base of the impression, surface moderately densely punctate. Elytra not wider than thorax in front and with suture, four discal costæ and margin feebly elevated, intervals with two rows of slightly elongate coarse punctures, each distinct. Body beneath rather coarsely punctured, first abdominal segment more coarsely than the others. Legs rufous. Length .08 inch ; 2 mm.

This species and the preceding are closely allied, but the present has a better defined thoracic concavity. The apical margin is also more distinctly thickened.

Occurs from District of Columbia to Florida.

L. pusillus Lec. New Species, 1863. p. 67 ; *laqueatus* Lec. Proc. Acad. 1866, p. 368.

Oblong-elongate, depressed, brownish or piceous, opaque, sparsely pubescent. Head sparsely punctulate and with a crescentic impression on each side. Thorax longer than wide, slightly narrower posteriorly, sides straight, margin entire, hind angles obtuse, apical margin thickened except at middle, and forming hook-like elevations surrounding the ends of obtuse carinæ which limit the broad median impression of the thorax, surface not densely punctured. Elytra slightly wider than the thorax, depressed variably but rather strongly costate, outer intervals biseriately coarsely punctate and also very finely punctulate. Body beneath moderately densely punctulate. Length .10–.12 inch ; 2.5–3 mm.

The elytral sculpture is variable as far as the costæ are concerned. The following forms occur:

pusillus Lec. type. Sutural interval feebly elevated, third interval feebly elevated at base, gradually becoming obsolete, fifth interval strongly elevated, seventh and margin less elevated than the fifth. Interval external to the fifth coarsely biseriately punctate, between the fifth and suture punctured at base, gradually becoming obsolete towards the middle.

laqueatus Lec. type, differs but little from the above except that the third interval is still less elevated and the coarser punctures less evident.

—— ——. Specimens from Vancouver have the coarse punctures in the interspaces between the fifth interval and the suture continued distinctly to the apex.

Occurs from Florida to Arizona and Vancouver.

Tribe III. COLYDIINI.

Antennæ capitate, retractile, inserted usually under a frontal margin at a short distance in front of the eyes. Head horizontal, eyes coarsely granulated, feebly prominent. Anterior coxæ small, moderately separated by a slightly elevated prosternum, the cavities closed behind, except in *Aglenus*. Middle coxæ moderately distant. Posterior transverse narrowly separated. Metasternal side pieces variable in width, or even concealed. Abdominal segments gradually decreasing in length, the fourth shorter than the fifth. Tarsi moderately long, the first joint as long or longer than the next two together, the three longer than the fourth.

This tribe differs from the preceding in the greater length of the first three tarsal joints and the comparatively smooth and glabrous surface of all the species. The difference founded on the greater length of the first abdominal segment is illusory.

The following genera occur in our fauna:

Anterior coxæ narrowly closed behind, prosternum at tip attaining the posterior margin..............................Group **COLYDII.**

Metasternal side pieces moderate. Anterior tibiæ finely denticulate at outer apical angle....................................**Aulonium.**

Metasternal side pieces linear. Anterior tibiæ with outer apical angle prolonged.......................................**Colydium.**

Anterior coxæ broadly closed behind, the epimera meeting on the median line, prosternum not attaining the margin....Group **NEMATIDII.**

Metasternal side pieces covered..........................**Nematidium.**

Anterior coxæ open behind. Head without eyes........Group **AGLENI.**

Metasternal side pieces narrow..............................**Aglenus.**

It is possible that the groups above indicated should be raised to the rank of tribes with the introduction of foreign genera. The most curious character presented by any of the above genera occurs in *Nematidium*, in which the arrangement of the posterior margin of the thorax beneath reproduces the normal structure of the Rhynchophora. This character was observed by me in 1870, while seeking for allies of *Cossyphus* in the present family, the latter having a similar sternal structure.

Aulonium is the only genus with representatives on both sides of the continent, although our one species of *Colydium* extends to Vancouver. *Nematidium* occurs only in the Southern States, while *Aglenus* has probably been introduced.

AULONIUM Erichs.

Antennæ eleven-jointed, club rather loosely triarticulate, inserted in front of the eyes under the expanded frontal margin. Eyes moderately prominent, rather coarsely granulated, emarginate in front by the sides of the clypeus. Anterior coxæ not widely separated. Posterior coxæ separated by a triangular acute abdominal process. Anterior tibiæ serrulate at outer apical angle and with two spurs, the anterior larger and arcuate. Tarsi with the first joint moderately elongate especially the middle and posterior, clothed beneath with moderately long hair.

Our species are separated as follows:

Hind angles of thorax rectangular.
Anterior margin of thorax with thickened edge. Humeri distinctly dentiform .... **paralellopipedum.**
Anterior margin not thickened but with two approximated dentiform elevations. Humeri not dentiform .... **longum.**
Hind angles of thorax obtuse.
Prosternum in front nearly smooth.
The two median lines of thorax nearly obliterated...... **tuberculatum.**
Prosternum in front scabrous or punctate.
The two median lines of thorax rather deeply impressed.. **ferrugineum.**

A. parallelopipedum Say, (*Colydium*) Journ. Acad. v, p. 263; *aequicolle* Lec. Proc. Acad. 1859, p. 81.

Piceous, moderately shining, legs and antennæ rufous, form oblong-elongate. Head moderately punctate, vertex obsoletely bituberculate. Thorax quadrate, apex slightly narrower and emarginate, base truncate, hind angles rectangular, sides very feebly arcuate from apex to base, disc with a sub-marginal impressed line limited externally by an elevation, another similar more internal, two feebly impressed sinuous lines at middle, between which and the adjacent carina the surface is elevated in an oblong tubercle near the apex; apical margin thickened: surface finely punctate. Elytra slightly wider than the thorax, humeri evidently dentiform, surface with rows of moderately fine closely placed punctures which become smaller toward the tip, intervals very finely punctulate. Body beneath moderately densely punctured. Prothorax more coarsely and densely. Length .18–.24 inch; 4.5–6 mm.

This species is so well known that it will serve as a point of comparison for our other species. In the ♀ the tubercle near the apex is very feeble or absent.

Widely distributed over the United States, one having been taken in California.

A. longum Lec. Proc. Acad. 1866, p. 378.

Rufo-piceous, moderately shining, more elongate and convex than the preceding. Head similar. Thorax longer than wide, sides parallel, slightly narrowed near the apex, sculptured similarly to *parallelopipedum* but with two central striæ nearly obliterated, the tubercles near the apex more elevated, the anterior margin not thickened, in the ♂ with two approximated dentiform elevations, ♀ simple. Elytra not wider than the thorax, humeri not dentiform, surface with faint traces of rows of punctures near the base, intervals very finely punctalate. Body beneath rather sparsely punctulate, under side of head and sides of prothorax more coarsely punctured. Length .18–.22 inch; 4.5–5.5 mm.

Occurs in Northern Arizona, Colorado and Oregon.

A. tuberculatum Lec. New Species, 1863, p. 67.

Elongate, sub-cylindrical, pale brownish, moderately shining, apical half of the elytra piceous. Thorax longer than wide, sides very feebly arcuate near the apex and base, hind angles very obtuse, apex without thickened margin but with two rather distant erect tubercles ♂, or simple ♀, disc with the sub-marginal and lateral carinæ, median lines almost entirely obliterated, anterior tubercles moderate ♂ or wanting ♀, surface sparsely punctulate. Elytra not wider than the prothorax, at base with nearly obsolete rows of punctures, intervals more finely punctulate. Body beneath and legs very sparsely punctulate, pale rufous. Length .18-.20 inch; 4.5-5 mm.

The humeral angles of the elytra are not dentiform. The head is as in *parallelopipedum*. This should be compared wtih *A. bicolor* of Europe.

Occurs in Georgia and Virginia.

A. ferrugineum Zimm. Trans. Am. Ent. Soc. 1869, p. 254.

Elongate, cylindrical, pale brownish, ferruginous, shining. Head punctulate, vertex not tuberculate. Thorax longer than wide, sides nearly straight, hind angles obtuse. apical margin not thickened, disc with the sub-marginal and lateral carinæ well developed, median impressed lines rather deep, converging in front, anterior tubercles obsolete, surface moderately punctate. Elytra not wider than the thorax, humeri not dentiform, surface finely punctulate with a very faint tendency to a striate arrangement near the base. Body beneath sparsely punctate. Prothorax more densely and coarsely. Length .14 inch; 3.5 mm.

This species is our smallest and most cylindrical. It differs from all the others in the absence of the tubercles of the vertex and is the only species in which the two lines at the middle of the disc are really well marked.

Occurs in Georgia and South Carolina.

COLYDIUM Fab.

Antennæ arising under the side of the head, eleven-jointed, last three forming a rather loose club, antennal grooves wanting. Anterior coxæ moderately distant, posterior separated by a triangular acute inter-coxal process. Tibiæ slightly broader at tip, not denticulate at outer angle, each with two short terminal spurs; tarsi with the first joint moderately long, fourth not longer than the others together, clothed beneath with moderate hair. Abdominal segments gradually shorter. Form slender, elongate.

C. lineola Say, Journ. Acad V, p. 264; Entomology, ed. Lec. II, p. 324; *nigripenne* Lec. New Species, 1863, p. 67.

Slender, cylindrical, elongate, piceous, moderately shining. Head moderately punctured. Thorax longer than wide, slightly narrower posteriorly, hind angles obtuse, sub-marginal stria very close to the lateral margin, another stria one-fifth from the same, a deeper median impressed line, surface moderately coarsely punctured. Elytra not wider than the thorax, base slightly elevated, each alternate interval finely costiform, interspaces between these biseriately punctate. Body beneath moderately coarsely punctate. Length .14–.26 inch; 3.5–6.5 mm.

This species varies in having the head and thorax rufous.

Occurs from Pennsylvania to Louisiana, also in Oregon and Vancouver.

C. longiusculum Say, loc. cit., is described as differing from the above in the absence of the median line. It has not been recognized since, and is considered doubtful.

NEMATIDIUM Erichs.

Antennæ eleven-jointed, club two-jointed, basal joint short, oval, partly uncovered, second cylindrical longer than the third, which is also longer than the fourth, four to nine short, gradually but very slightly broader, tenth trapezoidal, eleventh larger than the tenth, oval at tip and pubescent. Head slightly convex, feebly deflexed, antennal grooves distinct, rather deep, oblique. Eyes moderately coarsely granulate, sub-truncate in front. Anterior coxæ moderately separated by the prosternum which does not attain the hind margin of the thorax, the prosternal epimera meeting on the median line. Prothorax broadly concave at the sides for the reception of the legs, the sternal portion obtusely elevated, the lateral margin nearly entirely obliterated. Metasternal side pieces entirely concealed by the elytra. Abdomen with segments gradually decreasing in length, intercoxal process of the first very narrow and acute. Tibiæ with the apical angle prolonged, acute, and with two short terminal spurs. Tarsi slender, first joint elongate, longer than the next two together. Form linear, cylindrical.

The Rynchophorous affinities of this genus are not few nor unimportant, for besides the structure of the thorax beneath, the last joint of the antennæ has the anterior face and entire free margin pubescent while the posterior face is entirely glabrous as in many *Scolytidæ*. The almost entire absence of thoracic lateral margin is certainly a divergence from the *Colydiide* type, and an approximation to the *Scolytide*.

One species is known in our fauna which I am entirely unable to separate from a Brazilian form, and I am inclined to believe will prove to be *cylindricum* Fab.

N. mustela Pascoe, Journal of Entomology, II, 1863, p. 34, pl. 3, fig. 10; *filiforme* Lec. New Species, 1863, p. 68; ? *cylindricum* Fab. Syst. Eleut. II, p. 557.

Elongate, cylindrical, slender, piceous or brownish, moderately shining.

Head moderately convex and punctate. Thorax twice as long as wide, apex and base equal, sides very feebly sinuate at middle, lateral margin almost entirely obliterated, surface moderately punctate. Elytra one-fourth longer than head and thorax declivity slightly flattened, surface with finely punctured striæ, the sutural rather deeply impressed at the declivity, intervals with a single row of fine punctures. Body beneath sparsely, abdomen more densely punctate. Length .22–.26 inch; 5.5.–6.5 mm.

The identity of our species with *mutila* has been determined by comparison with one of Mr. Pascoe's specimens which Mr. Alex. Fry kindly gave to Dr. LeConte. I have very little doubt that the Fabrician name should prevail, but there is no other description published since the original, which is too short to enable one to identify the species in the absence of the type.

Occurs in North Carolina, Florida, Louisiana and in the Amazon region (Bates).

AGLENUS Erichs.

Antennæ free at the base, eleven-jointed, first joint rather stout, second cylindrical as long as the first, third nearly as long as the second, four to eight sub-equal, gradually broader. last three joints forming a fusiform mass. No antennal grooves. Mentum broad and short, supported by a distinct gular peduncle. Terminal joint of palpi oval, slightly truncate at tip. Eyes entirely absent. Anterior coxæ small, globular, narrowly separated by the prosternum which is oval at tip, cavities open behind. Middle coxæ narrowly separated. Posterior coxæ transverse, separated by a triangular, abdominal process. Tibiæ very slightly dilated at tip, terminated by short spurs. Tarsi short, the first three joints short, equal, last joint nearly as long as these together. First joint of abdomen slightly longer than the others, which are sub-equal. Scutellum not visible between the elytra.

All authorities agree regarding the position of this genus so far as its family affinities go, and all leave it where Erichson and Lacordaire have placed it, but I can find no reference to its most important character in any of the books—*the open anterior coxæ.* Duval (Gen. Col. Eur.) states particularly that the first three abdominal segments are closely connate, this seems to me not so, and I believe there is a certain amount of mobility in *Aglenus*, and also in *Cerylon*, *Philothermus* and *Discoloma*. There is certainly not the same fixity of structure that we find in the preceding tribes.

This discussion leads me to speak of *Anommatus*, a genus not yet represented in our country, and which has been associated with *Aglenus*, but removed by Duval to the LATHRIDIIDÆ. The latter determination appears to have been based on the mobility of the abdominal segments, and considering the present constitution of that family, as shown by the Munich Catalogue, Duval's idea at that time was not far wrong, the only wonder being that more genera did not get there. A comparison of *Aglenus* and *Anommatus*, indicates that they cannot be remotely separated, notwithstanding the fact that the abdomen is more mobile, and the tarsi three-jointed in the latter, their general similarity of structure, and the open anterior coxæ seem to have more weight in determining their association than any other characters have in separating them. The structure of the anterior coxæ and the form and narrowness of the sternum of *Anommatus* greatly resemble *Deretaphrus*, except that the latter has the coxal cavities closed behind while in the former they are open.

One species of *Aglenus* occurs in our fauna, probably introduced.

A. brunneus Gyll. (*Hypophlœus*) Ins. Suecc. III, p. 711 ; Duval Gen. Col. Eur. II, pl. 46, fig. 226 ; *Anommatus obsoletus* Shuck. Brit. Col. Delin. pl. 33, fig. 2.

Elongate-oval, brownish, shining, surface very sparsely punctate. Thorax very little longer than wide, sides feebly arcuate, margin very narrow. Elytra oval, emarginate at base, humeri rectangular. Body beneath sparsely punctured, rather more densely on the abdomen, and more coarsely than the upper surface. Length .06 inch ; 1.5 mm.

This species has occurred in our territory only at St. Louis, Mo., whence specimens have been sent me by Mr. Maurice Schuster.

Tribe IV. **DERETAPHRINI.**

Antennæ capitate, retractile, base free. Head deflexed, vertex convex, mouth inferior. Anterior coxæ globular, more prominent than the prosternum which is deeply depressed between them, contiguous or feebly separated, the cavities closed behind. Middle coxæ moderately separated, very closely approximated in *Oxylæmus*. Posterior coxæ at least moderately separated. Metasternal side pieces narrow. Abdomen with first

segment at least as long as the next two, 2–3–4 equal, fifth longer. Tarsi variable, long in two genera, rather short in *Oxylæmus*.

Our genera are three in number.

Tarsi rather short, the first three joints not as long as the fourth. Antennæ ten-jointed, club solid. Anterior coxæ contiguous, their cavities very narrowly closed behind.......................Oxylæmus.

Tarsi moderately long, first three joints longer than the fourth. Antennæ eleven-jointed, club three-jointed, anterior coxæ distinctly separated, their cavities distinctly closed behind................Deretaphrus.

Tarsi long, first joint always longer than the next two together, and that of the middle tarsus much longer. Antennæ eleven-jointed, club two-jointed. Anterior coxæ contiguous, their cavities distinctly closed behind..Sosylus.

In *Oxylæmus* the point of the prosternum is not visible behind the coxæ, and when the prothorax is not disarticulated the cavities are apparently open behind. They are really narrowly closed by the extension of the epimera to the slender point of the prosternum. In the other two genera the point of the sternum is distinctly visible behind the coxæ. *Deretaphrus* is further remarkable for the transverse impression immediately in front of the anterior coxæ.

Deretaphrus occurs in Oregon ; the other two genera have representatives on both sides of the continent.

OXYLÆMUS Erichs.

Antennæ ten-jointed, terminated by an abrupt club consisting of the enlarged glabrous tenth joint, at the tip of which the eleventh appears as a pubescent space, base free. Head beneath without antennal grooves. Eyes round, moderately coarsely granulated. Anterior coxæ contiguous, the cavity narrowly closed behind, prosternum extremely narrow, deeply depressed between the coxæ. Middle coxæ very closely approximated. Posterior coxæ separated by a triangular intercoxal process. Anterior tibiæ with the outer apical angle acute, slightly prolonged, and with two fine denticles at middle, middle and posterior tibiæ spinulose near the tip, all the tibiæ with short terminal spurs. Tarsi rather short, the first three joints together shorter than the fourth.

The anterior coxæ have been described as open behind, this has not been found accurate. On breaking a specimen it will be seen that the coxæ are rather prominent and conceal not only the point of the sternum, but also the extension of the epimera, so that while a specimen remains entire, the anterior coxal cavities seem to be open.

Two species are known in one fauna, one from each side of the continent and differing as follows:

Thorax very little longer than wide, first abdominal segment punctured only in front..**americanus.**
Thorax one third longer than wide, first abdominal segment very coarsely punctured over its entire surface.....................**californicus.**

The latter species is much more closely allied to the European *O. cæsus* than the former.

O. americanus Lec. New Species, 1863, p. 68.

Elongate cylindrical, ferruginous, shining, very sparsely clothed with semi-erect hairs. Head coarsely and deeply punctured. Thorax very little longer than wide, sides feebly arcuate, disc convex, coarsely and deeply but not densely punctured. Elytra scarcely wider than the thorax, disc with rows of moderately coarse punctures rather closely placed. Body beneath coarsely and deeply punctured. Abdominal segments punctured along their margins, the first segment coarsely punctured between the coxæ. Length .10–.12 inch; 2.5–3 mm.

Occurs in Pennsylvania, but rare.

O. californicus Crotch, Trans. Am. Ent. Soc. 1874, p. 75.

Thorax one-third longer than wide, very coarsely and deeply punctured, median line smooth, on each side at base a deep linear impression extending one-half to apex. Elytra feebly striate at base, and with rows of coarse, subquadrate punctures closely placed. Body beneath coarsely punctured. Length .12–.14 inch; 3–3.5 mm.

In all other respects this species agrees with the preceding.

Occurs in Calaveras County, California.

DERETAPHRUS Newm.

Antennæ at base free, received in deep, oblique grooves, eleven-jointed, last three forming a flattened mass truncate at tip. Head convex, deflexed, mouth inferior, in great part concealed by a prominent gular plate and the sides of the genæ, mentum retracted. Anterior coxæ moderately prominent, separated by a very narrow depressed sternum. Middle coxæ moderately distant. Posterior coxæ oval, separated by a quadrangular process, oval at tip. Anterior tibiæ moderately dilated, the apical angle prolonged, the outer margin finely bidenticulate, and with two terminal spurs, the anterior stouter and longer. Middle tibiæ rather less dilated, outer edge multidenticulate, two terminal spurs, the anterior longer. Posterior tibiæ similar to the middle, outer edge simple. Tibiæ within sparsely fimbriate. Tarsi moderately stout, first three joints gradually decreasing in length, fourth but little longer than the first.

D. oregonensis Horn, Trans. Am. Ent. Soc. 1872, p. 146.

Cylindrical, black, opaque. Head finely punctate. Thorax one-half longer than wide, base narrower than apex, sides in front feebly arcuate, basal half gradually sinuate, hind angles rectangular, disc sparsely punctate, a deeply impressed median line, not attaining the apex and divided into two unequal portions, and attaining the basal marginal line. Elytra with three discal costæ and margin moderately elevated, intervals with two rows of coarse, deep punctures not closely placed. Body beneath sparsely punctate, abdomen more finely. Length .42 inch; 10.5 mm.

This species bears a close resemblance to *fossus* Nm. and differs in the deeper thoracic line which more nearly attains the basal edge of the thorax, and by the costæ being much more elevated, especially that of the third interval, which is scarcely at all elevated in *fossus*.

Occurs in Oregon, and does not appear to be rare. It may be worthy of mention that the other species of this genus are from Australia.

SOSYLUS Erichs.

Antennæ eleven-jointed, last two joints forming an abrupt club, base free, received in repose in oblique grooves on the under side of the head, first joint oval, gibbous in front, so that the second joint appears to arise from the posterior side, second joint cylindrical, longer than the third, 3-9 about equal, ten and eleven forming an abrupt club, the eleventh longer than the tenth, and nearly semi-circular. Mentum not retracted, gular peduncle not prominent. Anterior coxæ contiguous, their cavities apparently confluent. Middle coxæ closely approximated. Posterior coxæ small, rounded, rather widely separated by a quadrangular process, arcuate in front. Anterior tibiæ moderately dilated, the apical angle prolonged, two terminal spurs, the anterior long and arcuate, the posterior small. Middle tibiæ similar to the anterior, but less prolonged at tip. Posterior tibiæ still less dilated, spurs small but unequal. Tarsi elongate, longer than the tibiæ, first joint nearly as long as the others together. First abdominal segment as long as the next three together, two to five gradually decreasing in length.

Our species are two in number.

Elytral intervals moderately densely punctulate. Genæ simple. . **costatus**.
Elytral intervals sparsely punctate. Genæ with a dentiform prolongation on each side. . . . . **dentiger**.

The latter character deserves more than a passing mention. It consists in a pyramidal prolongation downward of the sides of the genæ, being the extension of the ridge limiting the antennal groove in front. I can not recall the occurrence of any similar structure anywhere in the coleopterous series except in *Hypocephalus*, an insect without known relations. The appearance here of one of the peculiar characters of that genus has weight in confirming the view held by LeConte, of its Clavicorn affinities, and while we find this small link, it must not be forgotten that there are certain Rhynchophorous affinities in *Hypocephalus* as well as in several genera of the family now under consideration.

S. costatus Lec. New Species, 1863, p. 68.

Elongate, cylindrical, piceous, moderately shining. Head aciculate punctate. Thorax one-third longer than wide, narrowed at base, disc aciculate punctate, moderately convex. Elytra not wider than thorax, base feebly emarginate, basal margin at middle rather strongly reflexed, disc with four finely elevated lines, costiform at tip, and a fine sub-humeral stria, intervals sub-opaque, moderately densely and irregularly finely punctured, body beneath rather coarsely but not densely punctured. Length .16–.18 inch; 4–4.5 mm.

The sides of the genæ are merely slightly elevated in a plate, being a feeble reproduction of *Deretaphrus*, the antennal grooves are consequently less strongly marked than in the next species.

Occurs in South Carolina and Florida.

S. dentiger, n. sp.

Form and facies of the preceding differing as follows:

Head and thorax less densely punctured. Elytral lines more distinctly elevated, intervals irregularly, biseriately, sparsely punctulate. Length .20 inch; 5 mm.

The most marked distinction between these two species is in the presence of the pyramidal genal process already mentioned. Whether this character exists in any of the Brazilian species, I cannot say, as Mr. Pascoe systematically avoids all mention of the under surface of the majority of the *Colydiidæ* he describes.

Two specimens; Cape San Lucas, Lower California. I have also a specimen collected by Mr. Wm. M. Gabb in the Island of Santo Domingo, not distinguishable in any manner from those from Lower California.

Tribe V. PYCNOMERINI.

Antennæ capitate, retractile, inserted under a moderate frontal margin. Head horizontal, eyes rounded, coarsely granulated, feebly prominent. Anterior coxæ rounded, rather widely separated, closed behind. Middle coxæ distant. Posterior coxæ small, oval, very distant. Metasternal side pieces narrow. Abdominal segments sub-equal. Trochanters of all the femora free. Anterior tibiæ slightly dilated at tip, and with two unequal spurs. Tarsi moderate, first joint longer than either of the two following, the third longer than the fourth.

This tribe connects naturally with the preceding through *Oxylæmus*, but the affinities are very slight.

Two genera are known, both from the Atlantic region.

Antennæ 11-jointed, club 2-jointed........................**Penthelispa.**
Antennæ 10-jointed, club solid. ....**Pycnomerus.**

PENTHELISPA Pasc.

Endectus Lec. Class, Col. N. A. p. 91.

Antennæ eleven-jointed, terminated by a two-jointed club, inserted under a slight frontal margin, and without antennal grooves. Gula with a lateral ridge extending backward beneath the eyes, which are round and moderately prominent. Anterior tibiæ with outer apical angle prolonged, armed at tip with two spurs, the anterior longer and curved, middle and posterior dilated feebly at tip, and with two short terminal spurs. Trochanters distinct on all the legs. Abdominal segments decreasing gradually in length, the fifth slightly longer than the fourth and concave.

The characters of this genus otherwise do not differ much from *Bothrideres.* Mr. Pascoe says that the tibiæ are terminated by two or three spurs, which is to say the least a very loose expression, as no coleopterous insect ever has three spurs normally.

The principal differences between this genus and *Bothrideres* are the mode of insertion of the antennæ, the absence of antennal groove, the presence of trochanters on all the femora, and lastly the structure of the abdomen. The coxæ are all more approximated than in *Bothrideres.*

The following species occur in our fauna:

Thorax slightly wider than long, not narrowed behind, hind angles prominent..**hæmatodes.**
Thorax longer than wide, slightly narrowed behind, hind angles not prominent...**reflexa.**

P. hæmatodes Fab. (*Colydium*) Syst. El. II, p. 562; Say (*Lyctus*) Journ. Acad. V, p. 262; Am. Entom. edit. Lec. II. p. 323.

Moderately elongate, brownish, shining. Head coarsely punctured, front on each side impressed. Thorax slightly wider than long, not narrowed posteriorly, apex feebly emarginate, base broadly arcuate, the angles slightly prominent posteriorly, sides sinuate at middle, margin moderately reflexed, disc with a feeble longitudinal impression divided by a slightly elevated median line, surface coarsely, deeply and densely punctured. Elytra slightly wider than the thorax, base feebly emarginate, disc flattened, surface deeply and broadly striate, the striæ coarsely, deeply and closely punctured, intervals very narrow. Body beneath coarsely and deeply punctured. Length .14 inch; 3.5 mm.

Occurs from Pennsylvania to Texas, but not common.

P. reflexa Say, (*Lyctus*) Journ. Acad. V, p. 262; Am. Ent. edit. Lec. 322; *nitidus* Lec. (*Endectus*) New Species, p 69.

Thorax longer than wide, hind angles distinct but not prominent, sides extremely feebly sinuate at middle, straight or even slightly arcuate, margin narrowly reflexed, disc coarsely, deeply and densely punctured, median line sometimes smooth for a short distance at middle. Length .16 –.20 inch; 4–5 mm.

In all other characters this species agrees with *hæmatodes*. Occurs from Pennsylvania to Georgia.

PYCNOMERUS Erichs.

The only real difference between this genus and *Penthelispa* is, that the eleventh joint of the antennæ is closely united with the tenth, so that the club is solid and apparently one-jointed, glabrous at base, pubescent at tip.

P. sulcicollis Lec. New Species, 1863, p. 69.

Moderately elongate, castaneous, shining. Head sparsely punctured, front deeply impressed each side. Thorax slightly longer than wide, base very little narrower than apex, hind angles rectangular, sides very feebly arcuate, margin slightly reflexed, more distinctly in front, disc with two broad grooves at middle, which do not attain the apex or base, separated by the finely elevated median line, surface sparsely punctate. Elytra very little wider than the thorax, disc convex, striate, striæ with coarse, deep, elongate punctures. Body beneath coarsely and moderately densely punctured. Length .14 inch; 5.5 mm.

This insect has considerable resemblance to *P. hæmatodes*. Occurs in the Southern States.

Tribe VI. BOTHRIDERINI.

Antennæ capitate, retractile, at base free, insertion almost frontal, and close to the eye. Head deflexed, eyes coarsely granulated, rounded or slightly transverse. Anterior coxæ small, rounded, widely separated, closed behind, although very narrowly in *Bothrideres*. Middle coxæ widely separated. Posterior coxæ small oval, very widely separated. Metasternal side pieces narrow. Ventral segments unequal, the first elongate, the next three sub-equal, the fifth slightly longer. Trochanters closely connate with the femora. Tarsi moderate, first joint always longer than either of the two following, the three longer than the fourth. Anterior tibiæ with one terminal spur.

Of the genera placed here by Erichson, *Bothrideres* alone remains. As a tribe this is probably the best defined of all, exhibiting in our fauna less affinity with the other tribes than they do among themselves.

Our genera are two in number.

Head horizontal or nearly so; anterior coxæ narrowly closed behind, tibiæ not prolonged at outer angle.

Antennæ 11-jointed, club 2-jointed........................**Bothrideres.**

Head deflexed; outer angle of anterior tibiæ prolonged; anterior coxæ very distinctly closed behind.

Antennæ 11-jointed, club 2-jointed........................**Machlotes.**

(Antennæ 9-jointed, club with one solid joint............**Emmaglæus.**)

The latter genus has no place in our fauna, but has been introduced to show its correct position. Fairmaire describes the antennæ as 11-jointed, but I can find but nine, the structure of these, and an excellent figure being given by Lacordaire, Genera, Atlas, pl. 17, fig. 5, reference to which is omitted in the Munich Catalogue.

MACHLOTES Pasc.

Prolyctus Zimm. Trans. Am. Ent. Soc. 1869, p. 274.

Antennæ eleven-jointed, terminated by a small club of two joints, first joint stout, oval, second a little longer than the next, three to nine small, equal, tenth triangular truncate, eleventh small, transversely oval, partially retractile; base of antennæ free, received in repose in short, oblique grooves. Head deeply inserted, broader than long, deflexed, side margin acutely incised over the insertion of the antennæ. Eyes transversely oval, moderately prominent, coarsely granulated. Gular region deeply emarginate, the lateral plates concealing the maxillæ, mentum short, transverse, deeply, transversely impressed, last joint of palpi elongate conical. Anterior coxæ widely distant. Middle coxæ equally distant. Posterior coxæ small, oval, very widely distant. Anterior tibiæ dilated at tip, the outer apical angle spiniform, outer edge with few denticulations, terminated by a single stout spur. Middle and posterior tibiæ not dilated, terminated by two short spurs. Trochanters of all the legs connate, with the femora without suture. Tarsi not elongated, first and fourth joints sub-equal, either nearly as long as the second and third together. Abdomen with first segment as long as the next three together, joints two to five gradually shorter. Thorax and elytra costate, the former with a deep, transverse impression posteriorly.

This genus was described by Mr. Pascoe in the Journal of Entomology II, p. 36, for certain East Indian species allied to *Bothrideres*, to which must be added our *B. exaratus*. Closely allied to this genus is *Emmaglœus* Fairm., which differs in the presence of a distinct groove on the under side of the thorax indicating the suture between the pronotum, and the prosternal side pieces, and also in the structure of the antennæ, and sculpture of the surface. Both genera have the side of the front incised at the end of the frontal suture over the insertion of the antennæ, and there are distinct coxal lines on the first abdominal segment as in several of the genera of *Monotomidæ*.

M. exaratus Mels. (*Bothrideres*) Proc. Acad. II, p. 111; *geminatus* Hald. Proc. Acad. I, p. 104.

Form oblong, black, opaque. Head coarsely and moderately densely punctured. Thorax broader than long, apex emarginate, angles slightly prominent in front, base feebly arcuate, sides gradually arcuate and slightly narrowed to base, disc feebly convex, on each side three carinæ, the outer entire, the inner extending two-thirds slightly sinuate and converging toward the middle of the apical margin; posteriorly, at basal third is a deep, transverse impression, from which less deep impressions proceed to the hind angles and toward the scutellum; in front of the deep impression are two oval tubercles not elevated above the surface of the disc, surrounded by a deep groove; intervals moderately, coarsely punctured. Elytra wider than the thorax, elongate oval, humeri oblique, each elytron with four costæ, and margin acutely elevated, and a distinct sutural stria, intervals obsoletely punctulate. Prothorax coarsely punctured beneath, body less coarsely. Abdomen sparsely and rather finely punctate, first segment with two parallel coxal lines nearly attaining the posterior margin, the first three segments in addition a fine sub-marginal line at the sides. Length .16–.26 inch; 4–6.5 mm.

This insect occurs especially in the Southern States.

BOTHRIDERES Erichs.

Antennæ eleven-jointed, last two forming an oval club, received in repose in oblique antennal grooves, insertion exposed by an incision of the sides of the front. Head prominent, horizontal, eyes oval, prominent, coarsely granulated. Trochanters of anterior legs distinct, those of middle and posterior connate, with the femora without suture. Thorax more or less excavated at middle, and without elevated lines. Humeri rounded, the angle incurved. In its other characters this genus agrees with *Machlotes*.

Two species occur in our fauna.

Thorax rather deeply excavated, abdomen sparsely punctulate..**montanus.**
Thorax vaguely concave, abdomen coarsely and deeply punctate.**geminatus.**

B. montanus, n. sp.

Oblong, moderately elongate, ferruginous brown, shining, very sparsely pubescent. Head coarsely and moderately densely punctured. Thorax longer than wide, narrower at base, apex emarginate, angles slightly prominent, base arcuate, sides feebly arcuate, a small tooth at the middle of the margin, posterior angles distinct, disc with two deep foveæ at middle, the anterior larger, surface coarsely and densely punctured, sparsely pubescent. Elytra slightly broader than the thorax, moderately elongate, base emarginate, humeri rounded, the tip of humeri inflexed, disc moderately convex, surface striate, striæ punctured, intervals alternately more elevated, pubescent and distinctly punctured, the seventh sub-costiform, intermediate intervals flat, smooth. Prothorax beneath coarsely and deeply punctured. Abdomen rather sparsely and finely punctured. Femora sparsely punctured, tibiæ densely punctured and pubescent. Length .18–.24 inch; 4.5–6 mm.

Taken by Mr. H. K. Morrison in the mountains near San Juan, Colorado.

B. geminatus Say, (*Lyctus*) Journ. Acad. V. 262; Am. Ent. edit. Lec. II, p. 323.

Oblong, moderately elongate, ferruginous or brownish, moderately shining. Head densely and moderately coarsely punctured. Thorax longer than wide, narrower behind, apex feebly emarginate, sides feebly arcuate, a feeble dentiform tubercle at middle of margin, disc vaguely concave, coarsely and moderately densely punctured, a smooth spot at middle of apical margin. Elytra as in the preceding, disc flat ♂ or slightly convex ♀, surface striate, striæ finely punctured, intervals alternately wider, the wider intervals with a single series of punctures, and slightly pubescent, the narrower smooth. Body beneath coarsely and deeply punctured. Legs as in the preceding. Length .10.–18 inch; 2.5–4.5 mm.

This species differs in many characters from the preceding, the thoracic, elytral and abdominal sculpture being the most important.

Appears to be widely diffused, occurring in the Atlantic region, extending west to Kansas and south to Texas, also in the Island of Santo Domingo (Gabb).

Tribe VII. CERYLONINI.

Antennæ capitate, retractile, free at base, insertion frontal. Head retracted, slightly deflexed, eyes round, moderately coarsely granulated. Anterior coxæ round, rather narrowly separated. Middle coxæ more widely separated. Posterior coxæ oval, widely separated. Metasternal side pieces extremely narrow. First ventral segment as long as the three following together, 2–4 short, equal, fifth slightly longer. Palpi with the terminal joint acicular, the penultimate ovoid. First three joints of tarsi short, together shorter than the fourth.

For the present, two genera may be considered as consituting this tribe in our fauna, although it might with propriety be divided into two.

Anterior coxæ closed behind.
  Anterior 10-jointed, club with one joint........................**Cerylon.**
Anterior coxæ open behind.
  Antennæ 11-jointed, club 2-jointed.....................**Philothermus.**

In the latter genus I have observed a distinct onychium with two terminal setæ, this character has entirely escaped me in the other genera if it exists.

From this tribe I have removed *Murmidius* and *Mychocerus* placed here by Crotch and Erichson, to follow the example of Duval in forming for them a distinct family.

CERYLON Latr.

Antennæ ten-jointed, terminated in a club of one joint, evidently the union of two, insertion almost frontal, without antennal grooves. Head small, deeply inserted, narrowed in front of the insertion of the antennæ. Eyes narrow, transverse. Palpi with last joint small, acicular, penultimate, large, ovoid. Anterior coxæ widely distant, the prosternum broad and dilated behind them. Middle coxæ more distant than the anterior. Posterior coxæ small, oval, very widely distant. Tibiæ slightly broader toward the tip; with small terminal spurs. Trochanters evident. Abdomen with first segment nearly as long as the others together, the next four segments equal. Scutellum small, transverse.

I have examined our species with a great deal of care on a large series of specimens, and am entirely unable to find more than one true species.

C. castaneum Say, Jour. Acad. V, p. 259; Am. Ent. edit. Lec. II, p. 321; *unicolor* Zieg. Proc. Acad. II, p. 70; *simplex* Lec. Pac. R. R. Rep. 47 par. Vol. IX, App. 1, p. 39; *angustulum* Lec. New Species, 1863, p. 69.

Oblong-elongate, castaneous or piceous, shining, depressed. Head sparsely punctate. Thorax nearly square, sides in front slightly arcuate, hind angles rectangular, disc depressed or very feebly convex, a slight impression on each side of middle at base, surface rather coarsely but not densely punctured. Elytra scarcely wider at base than the thorax, sides feebly arcuate, disc depressed, surface striate, striæ punctured. Body beneath rather sparsely punctate. Length .08–.12 inch ; 2–3 mm.

This species occurs over our entire country from the Atlantic to the Pacific, and from Hudson's Bay to Texas.

PHILOTHERMUS Aubé.

Antennæ eleven-jointed, last two joints forming an abrupt club, the terminal joint longer than the tenth, second and third joints moderately long equal, inserted as in *Cerylon*, antennal grooves absent. Head and palpi as in *Cerylon*. Anterior coxæ moderately separated, the prosternum oval at tip, coxal cavities open behind. Tibiæ slightly broader from the base, narrowed at tip, the apical angle not prolonged, and without terminal spurs. Middle coxæ more distant than the anterior. Posterior coxæ widely distant. Trochanters distinct on all the femora. First abdominal segment as long as the next three together, segments two to five nearly equal. Scutellum transverse. Tarsi with the first three joints very short, very little longer together than half the fourth.

The points of difference between this genus and *Cerylon*, with which it has been associated, are many. The most important is the open anterior coxæ, following which in value is the structure of the antennæ, and lastly the form of the tibiæ which resemble *Cicones*, and have no spurs.

Two species are known in our fauna.

Body beneath rather sparsely punctured, above glabrous ; punctures not attaining the tips of the elytra which are nearly smooth. **glabriculus.**
Body beneath coarsely and deeply punctured, above pubescent ; punctures attaining the tips of the elytra..**puberulus.**

P. glabriculus Lec. New Species, 1863, p. 69.

Elongate-oval, castaneous, shining, glabrous. Head sparsely punctate. Thorax broader than long, broader at base, apex emarginate, base feebly bisinuate, sides regularly arcuate from apex to base, margin moderately reflexed, disc sparsely and regularly punctate. Elytra not wider than the elytra, and with rows of rather coarse punctures not closely placed, evanescent at the tip, striæ not impressed. Body beneath sparingly punctate, especially along the middle. Length .08–.12 inch ; 2–3 mm.

This species occurs especially in the Atlantic States proper. not extending westward.

P. puberulus Schwarz, *ante*, p. 361.

Elongate-oval, castaneous, shining, surface sparsely clothed with short, erect hairs. Thorax rather coarsely but sparsely punctate, margin more narrowly reflexed. Elytra with rows of moderately coarse punctures which attain the tip of the elytra, but become somewhat feebler at tip. Body beneath with coarse sparse punctures. Length .08 inch nearly ; 2 mm.

This species although quite distinct from *glabriculus* in appearance has but little to distinguish it except the pubescent surface, the coarser abdominal punctuation, and a somewhat more elongate and compact antennal club.

Collected by Messrs. Hubbard and Schwarz at Sand Point, Florida. I have a specimen from Arizona not differing except that the surface sculpture is a little less strongly marked.

NOTES ON DISTRIBUTION OF GENERA AND SPECIES.

Species peculiar to the Eastern States	26
Species peculiar to the Pacific Region	13
Species common to these two regions,	
Aulonium parallelopipedum, Colydium lineola,	
Cerylon castaneum, Philothermus puberulus.	
Species occurring from Colorado to the Pacific,	
Lasconotus complex, Aulonium longum.	
Species occurring in Lower California and Santo Domingo,	
Sosylus dentiger.	
Species occurring in the Gulf States and Brazil,	
Nematidium mustela.	
Species common to Europe and United States,	
Aglenus brunneus.	
Genera represented only in the Eastern States	8
Genera represented only in the Pacific Region	5
Genera common to these two regions	10
Genera common to Europe and United States	13
of which there occur both on the Atlantic and Pacific	8
in the Atlantic Region only	4
in the Pacific Region only (*Endophlœus*)	1
Genera peculiar to United States (2 Pacific, 1 Atlantic)	3
Genus occurring only in Oregon and Australia	*Deretaphrus.*

The following genera have been placed with the *Colydiidæ*, and, as mention has been already made of their exclusion, it is proper that they should be appended to the main essay.

MURMIDIIDÆ.

The differences between this family and the Colydiidæ have been pretty fully dwelt upon by Duval in the Genera of Coleoptera of Europe, so that comparatively little may be added.

The parts of the mouth are very difficult to examine, but those of *Mychocerus* seem not remarkably different from those of *Cerylon*, especially in the form of the palpi. The head is completely retractile in *Murmidius* and the parts of the mouth are concealed beneath by a distinct prosternal lobe, while in *Mychocerus* the head is less retracted and the lobe very short. The antennæ are rather frontal in their insertion resembling the Histeridæ, ten-jointed, terminated by a solid club composed evidently of two joints united, the basal joint is stout, and the joints of the funicle are suddenly geniculate, the club being received either in a cavity at the anterior angle of the thorax, open above (*Murmidius*), or in a cavity in the front of the anterior angle not opening above (*Mychocerus*). The anterior coxæ are small and round, their cavities open behind, but completed by excavations in the anterior border of the mesosternum, which is closely applied to the posterior edge of the prothorax. The middle coxæ are small and as distant as the anterior. The posterior coxæ are small, very slightly oval and almost completely surrounded by the metasternum in front and the first abdominal segment behind. The prosternum is broad, flat and bistriate. The metasternal side pieces are concealed by the epipleuræ in *Murmidius* but are quite distinct in *Mychocerus*. The legs are retractile and received in excavations at the sides of their respective sterna, the cavities for the posterior being partly in the first abdominal segment. The abdomen is as in *Cerylon*, the first segment being long the others short and each slightly shorter than the preceding. The tarsi are four-jointed, the last joint being as long as the others together.

The essential difference between this family and the Colydiidæ are found in the presence of the antennal cavities and their position, the presence of a prosternal lobe more or less marked, the structure of the anterior coxal articulation, the legs retractile and finally the structure of the posterior coxal cavities. In the latter character there is some resemblance to *Discoloma*.

The resemblances to the Histeridæ entirely escape me except in the retractility of the legs, while the structure of the anterior coxæ is so widely different in the two families as to completely outweigh the more trifling similarities.

Two genera represent this family in our fauna which differ as follows:

Antennal cavity visible from above; prosternal lobe well marked concealing the parts of the mouth beneath; metasternal side pieces concealed by the epipleuræ..**Murmidius.**

Antennal cavity opening in front, not visible from above; prosternal lobe truncate; metasternal side pieces with the sutures very evident...... **Mychocerus.**

MURMIDIUS Leach.

The clypeus is broader before the insertion of the antennæ and the labrum retracted. The antennal cavities are distinctly visible from above. The epipleuræ although narrow, cover completely the metasternal side pieces so that these are only visible at the posterior extremity (in the excavation for the leg) where they turn slightly inward to meet the coxæ.

M. ovalis Beck, Beitr. bair. Faun. 1817, 1; Duval, Gen. Col. Eur., pl. 56, fig. 276.

Ovate, convex, brownish, shining, sparsely clothed with an extremely fine pubescence. Thorax transverse, narrower in front, surface very finely punctulate and with a slight depression above the antennal cavity. Elytra with rows of distant punctures which become rapidly evanescent toward the apex and sides. Beneath very sparsely punctulate. Length .05 inch; 1.25 mm.

This insect is very rare in our country and has probably been introduced. Specimens were given me by Mr. O. E. Janson, of London, England, who found them abundantly in some old straw.

MYCHOCERUS Erichs.

Zimmerman, Trans. Am. Ent. Soc., 1869, p. 255.

Labrum visible, parts of mouth visible from beneath, prosternal lobe short. Antennal cavity at the anterior angle of the thorax, not visible from above. Epipleuræ wider than in *Murmidius*, not covering the metasternal side pieces.

So many of the characters have been given among the generalizations at the head of the family and by Zimmerman that it is not necessary to repeat them here.

M. depressus Lec. (*Murmidius*) Proc. Acad. 1866, p. 376; Zimm. loc. cit.

Broadly oval, depressed, ferruginous brown, sparsely pubescent. Thorax transverse, sparsely punctulate, sides moderately arcuate and narrow in front, base slightly narrower than the elytra. Elytra with rows of moderately coarse punctures which gradually become feebler toward the sides and tip. Body beneath very sparsely punctate. Length .04 inch; 1 mm.

This species occurs from District of Columbia to South Carolina, and very rare.

The Coleoptera of Michigan.

BY H. G. HUBBARD AND E. A. SCHWARZ.

(Read before the American Philosophical Society, April 18th, 1878.)

1. *Descriptions of New Species by* JOHN L. LECONTE, M.D.

I have written these descriptions in order that fewer species without names may be referred to in the two lists which form the bulk of the present memoir.

The lists of the Coleoptera of the Upper and Lower Peninsulas of Michigan respectively, have been prepared by the authors with great care, after extensive explorations and collections in the two regions. The species, as far as described, have been identified with the series contained in my collection, and I cannot sufficiently express my thanks, to both Mr. Hubbard and Mr. Schwarz, for the great liberality with which they have given me even unique specimens, so that all the material necessary for comparison and investigation is placed in one single collection. My series, therefore, both of Florida and Michigan Coleoptera, contain all the species catalogued in their lists, and a basis for future studies in geographical distribution has been thus firmly established.

I have added to the list of the species from Lake Superior all those collected in my own extensive explorations of that basin, which were not contained in the collections of the authors. This list is therefore to be considered as a complete catalogue of the Coleopterous fauna of that region, so far as at present known, and exhibits some very interesting points in geographical distribution.

Especially worthy of notice is the large proportion of species common to Lake Superior and Alaska, and if types of the other species described by Mannerheim and Mäklin were accessible for comparison, the number of forms in this category could doubtless be still farther increased. Space and time alike forbid my making a separate list of such species on the present occasion, but I intend to recur to the subject again, when larger series from the Alpine heights of the Rocky Mountains have been collected. The occurrence at Lake Superior of *Euthia scitula* and *Syntomium confragosum*, previously known only from Alaska, and *Gonotropis gibbosa* from Colorado, deserves mention ; as also the extension northward of *Callida smaragdina*.

1. **Dyschirius brevispinus.** Shining black, feebly bronzed, rather robust, antennæ, palpi, and legs rufous. Epistoma very slightly emarginate, angles not prominent, transverse impression deep, frontal impressions also deep. Prothorax longer than wide, oval, a little wider behind ; lateral margin extremely fine, scarcely continued behind the posterior lateral puncture. Elytra oval, as wide as the prothorax, brownish at the tip, base not margined ; striæ uniformly abbreviated in front, very coarsely punctured, obliterated a little behind the middle, 8th represented at the tip by a short groove ; scutellar puncture large ; dorsal punctures two, one on the 3d interspace near the base, the 2d near the 2d stria about the middle. Front

tibiæ not toothed on the outer edge, terminal digitation long, slender, curved; spur not longer than the first joint of the tarsus. Length 3.4 mm.; .135 inch.

Detroit; one specimen. This species is very distinct by the small size of the lower spur of the front tibiæ, and may be placed as a separate division in B, *A*, a, of my table (Proc. Ac. Nat. Soc. Phila. 1857, 76.) before *sphæricollis*.

2. **Badister obtusus.** Piceous, shining; prothorax, base of antennæ, palpi and legs testaceous; elytra piceo-testaceous, lateral margin and base testaceous. Prothorax wider than long, narrower behind, hind angles rounded, indistinct, side margin not wider towards the base, which is not explanate towards the sides, basal impressions rounded, not extended towards the sides; dorsal line deep, transverse impressions feeble. Elytra with well-marked striæ, interspaces nearly flat, 3d with two dorsal punctures contiguous to the 2d stria. Length 5.8 mm.; .23 inch.

Marquette, Lake Superior; one specimen. More allied to the Californian *B. ferrugineus* than to any other in my collection, but easily known by the more rounded hind angles of the prothorax.

3. **Bembidium** (Notaphus) **arcuatum.** Black, with a greenish bronzed lustre. Antennal scape, palpi and legs piceo-testaceous. Elytra piceous, with ill-defined testaceous markings, viz.: a humeral cloud, lateral narrow margin, curved band behind the middle, which is concave backwards, and apex; epipleuræ black and testaceous. Prothorax wider than long, rounded on the sides, strongly sinuate behind, base as wide as the apex, hind angles rectangular, carinate; basal impressions deep, dorsal line well-impressed, transverse impressions feeble. Elytra elongate-oval, humeri rounded, striæ distinctly punctured to behind the middle, then finer and smoother; 8th stria deep near the tip; dorsal punctures two, on the 3d interspace. Length 5.4 mm.; .21 inch.

Marquette, Lake Superior. This species resembles *B. flammulatum* of Europe, but is wider and less convex. It also greatly resembles *B. incrematum* Lec. from Cala., Oregon and Alaska, but the latter has the elytral markings undefined, and the striæ finer and less strongly punctured.

4. **Bembidium** (Notaphus) **versutum.** Beneath black, shining; above bronzed; head and prothorax not polished; antennæ piceous, base, palpi and legs testaceous. Prothorax wider than long, narrowed behind, sides rounded in front, strongly sinuate behind, base not narrower than the apex; basal angles rectangular, carinate, basal impression rugose, deep; dorsal line abbreviated at each end, transverse impressions obsolete. Elytra elongate-oval, wider than the prothorax, humeri rounded, angles slightly marked; striæ entire, fine, finely punctulate to behind the middle, inter-

spaces flat, 3d with two dorsal punctures; color brown with metallic lustre, with large ill-defined testaceous markings arranged as in *B. indistinctum*, epipleuræ testaceous edged with black. Length 4.3 mm.; .17 inch.

Marquette, Lake Superior. Smaller and less convex than the preceding, with the prothorax wider and not polished. This species resembles the Californian *B. approximatum* and *indistinctum* in form and markings, but differs by the sides of the prothorax more strongly sinuate towards the base, and by the head and prothorax being less shining, and of a brown-bronze, not green-bronze color.

5. **Hydroporus fuscatus** *Crotch.* Oblong-oval, elongate, pointed behind, shining brown above, mottled with darker; antennæ with the outer joints blackish. Prothorax slightly rounded on the sides finely and distinctly punctured, basal plica extending a short distance upon the elytra, which are more strongly and not densely punctured. Metasternum with a few scattered punctures, and three striæ behind. Length 1.7 mm.; .065 inch.

Detroit and Lake Superior. Allied to *affinis*, but the elytra are more strongly and sparsely punctured; the continuation of the stria upon the elytra is very short, and forms an angle with the thoracic stria. Among 14 specimens examined I find no sexual difference worthy of note, and I have redescribed this species in order to correct an error made by Mr. Crotch, who (Trans. Am. Ent. Soc. 1873, 391,) considered as the ♀ a different species, in which the stria is not continued upon the elytra.

6. **Hydroporus laccophilinus.** Ovate, depressed, pointed behind, brown, paler in front, darker behind; epistoma not margined, head finely punctulate; prothorax (♂) rugose and finely punctured, narrower in front, sides oblique, finely margined. Elytra (♂) strongly punctured, shining, (♀) opaque, finely sparsely punctulate. Metasternum channeled for the posterior half of its length; sparsely punctured in front; abdomen coarsely punctured in both sexes. Length 2.6 mm.; .10 inch.

Detroit; rare. The form is exactly that of a *Laccophilus* in miniature. The head and prothorax of the ♀ are opaque and very finely and sparsely punctulate.

7. **Suphis semipunctatus.** Elongate-oval, not pointed behind, moderately convex, yellow-brown, shining, smooth; elytra darker, covered from the middle to the tip with scattered coarse punctures; of which one series extends to the base half way between the margin and suture. Pros-

ternum not punctured, less dilated behind than in the other species, but with two short posterior striæ; metasternum with a deep impressed median line, smooth, with only a few scattered punctures behind. Length 26 mm.; .10 inch.

Monroe, Michigan; one specimen; very different from the other species by the regularly oval form, scarcely narrower behind than before, by the peculiar punctuation of the elytra and by the impunctured sterna. The last joint of the maxillary palpi is nearly acute at tip, and does not appear emarginate from any point of view.

The insect mentioned in the Florida list (ante p. 438) as *Suphis* n. sp., on remounting, proves to be a very small species of *Laccophilus*, having the same form of prosternum as the others. It may be here conveniently described as:

8. **Laccophilus pumilio.** Ovate, pointed behind, not convex, impunctured, rufo-testaceous, meso- and metasternum darker; elytra piceous, slightly iridescent, regularly narrowed behind, and not obliquely truncate at tip; abdomen without the distant fine oblique lines seen in the other species. Length 1.9 mm.; .075 inch.

Enterprise, Florida; one specimen. Very careful examination shows in certain lights traces of two or three lines on the second ventral segment towards the sides, but these are the only evidences of the characteristic ventral sculpture of the other species.

9. **Gaurodytes leptapsis.** ♀ Elongate-oval, less obtuse than usual, black, with a slight bronzed tint, opaque, finely strigose with lines forming very elongate meshes; base of antennæ, palpi, front and middle legs tinged with piceous. Head less opaque than the prothorax, the sides of the latter are oblique, finely margined and scarcely rounded. Elytra with the usual rows of punctures indistinct. Beneath shining, finely reticulate, mesosternum acutely emarginate, hind tibiæ sparsely, coarsely punctured, margined on the inner side, but without a very distinct row of punctures. Front and middle thighs distinctly, not densely punctured. Length 9.7 mm.; .38 inch.

Marquette, Lake Superior; one specimen. This species is as elongate as *G. parallelus*, but less obtusely rounded, and is easily recognized by the peculiarily elongated meshes of the reticulation. The prosternum is obtusely carinate.

10. **Gaurodytes longulus.** Elongate-oval, obtuse at each end, not convex, shining, smooth black, with a slight metallic gloss. Antennæ, palpi

and feet tinged with piceous. Prothorax with sides oblique, finely margined; apical and basal rows of punctures strongly marked. Elytra with the rows of punctures strongly marked. Prosternum acutely carinate; mesosternum deeply emarginate; front and middle thighs punctured and rugose; hind tibiæ smooth, with a few small punctures at the inner margin and some larger ones along the outer margin. Length 9 mm.; 35 inch.

♂ Smooth but not polished; claws of front tarsi long, not toothed, curved only near the tip.

♀ Scarcely perceptibly punctulate; claws of front tarsi not so long, and regularly curved.

Lake Superior; the elytra vary from brown to black, with only the edge brownish. The form is exactly as in *G. parallelus*, from which it differs greatly by the other characters.

11. **Hydrobius feminalis.** Sub-ovate, convex, blackish piceous, sides of prothorax and elytra and beneath paler. Head and prothorax sparsely punctulate, elytra finely not densely punctured, sutural stria deep, extending from the middle to the tip. Length 2 mm.; .08 inch.

Detroit. This species is less oval than the others of the same size in our fauna, and is somewhat narrower behind than in front; it is free from metallic lustre. The prosternum and mesosternum are not prominent, and the thighs are punctulate and pubescent from the base nearly to the knees. It therefore belongs to the genuine Hydrobii, and is allied to the two following Californian species.

12. **Hydrobius castaneus.** Oval, convex, shining brown, beneath piceous. Head prothorax and elytra finely, moderately densely punctured, the latter a little more strongly; sutural stria deep, extending from the middle to the tip. Length 2.5 mm.; .10 inch.

Lake Tahoe, Cal.; Mr. Crotch. The pro- and mesosternum are not carinated, and the thighs are punctulate and pubescent except near the knees.

13. **Hydrobius cuspidatus.** Oval, more elongate and somewhat less convex; blackish piceous, paler at the sides of the head and prothorax, also along the basal and apical margins of the latter; finely punctured, rather more strongly upon the elytra, with here and there indistinct traces of rows. Length 3.4 mm.; .14 inch.

Lake Tahoe, Cal.; Mr. Crotch. The prosternum is not carinate; the mesosternum is strongly carinate, with the anterior angle rectangular and slightly cuspidate. The under surface and thighs are punctulate and pubescent almost to the knees.

14. **Habrocerus? magnus.** Elongate, depressed, blackish piceous. Head and prothorax shining, polished, the former with one frontal puncture each side. Prothorax twice as wide as long, emarginate at tip, broadly rounded at base, narrowed in front, strongly rounded on the sides, basal angles much rounded; sides finely margined, with two marginal punctures, and one in the base near the angle, base very finely margined; disc with one setigerous dorsal puncture each side. Elytra finely punctured and pubescent, with some feeble traces of striæ near the base towards the suture. Dorsal segments densely punctulate. Beneath finely punctured and pubescent; tip of abdomen, antennæ, palpi and legs piceous. Length 3.8 mm.; .15 inch.

♂ 6th ventral segment acutely emarginate, 7th more deeply emarginate almost to the base, 8th prominent, rounded at tip.

♀ Ventral segments not emarginate.

Isle Royale, Lake Superior. This species differs from *H. Schwarzi* by the much greater size, more elongate and depressed body, and pubescent elytra; it seems to be a connecting form between this genus and *Tachinus.*

15. **Agathidium globatile.** Black, shining, completely contractile into a ball. Head and prothorax smooth. Elytra smooth, without sutural stria, finely margined, margin extending along the base almost to the scutellum, which is large and triangular. Length (when contracted 2 mm.; .08 inch.

Marquette and Detroit. Much smaller than *A. oniscoides*, but not otherwise specially different.

16. **Agathidium parvulum.** Hemispherical, not contractile, rufo-piceous, shining, smooth, elytra with sutural stria extending from the middle to the apex. Length 1.2 mm.; .05 inch.

Marquette, Lake Superior. This is the smallest species in my collection, and is less contractile than any other known to me.

17. **Staphylinus cæsareus** *Cederholm;* Er. Staph. 378.

A specimen of this European species, found at Detroit, differs by having the golden pubescence confined to the neck and to the posterior margin of the second dorsal segment. No golden hairs are visible either at the base and apex of the prothorax or on the sides of the ventral segments.

18. **Batrisus simplex.** Rufous, shining, sparsely pubescent. Head

slightly scabrous, vertex slightly elevated and convex, surrounded by a shallow curved impression. Prothorax campanulate, with the dorsal and lateral striæ deep; behind the middle between the striæ each side is an acute conical tubercle, and still nearer the base two very small teeth. Elytra indistinctly and sparsely punctulate. Antennæ with the joints 3–8 not longer than wide, 9th and 10th rounded gradually larger, 11th still larger, oval, pointed. Hind tibiæ with long terminal spur. Length 2 mm.; .08 inch.

♂ Head finely scarbrous, front protuberant anteriorly and retuse, with an apical concavity.

♀ Head nearly smooth, vertex entirely smooth, front gradually declivous not prominent.

Detroit; one pair. Sufficiently distinct by the feeble sculpture of the head, and the absence of antennal sexual characters.

19. **Orthoperus scutellaris.** Oblong-oval, slightly convex, piceous, black, glabrous, not very shining. Scutellum large, very distinct. Elytra narrowly margined behind with testaceous. Length .7 mm.; .027 inch.

Michipicoton River, north shore of Lake Superior; also found in Illinois, and abundantly in British Columbia, at Lake Labache. This species is double the size of *O. glaber*, and less rounded. It is recognized at once by the very distinct scutellum.

Under a high magnifying power the elytra are seen to be finely strigose, and very sparsely and indistinctly punctulate.

20. **Orthoperus suturalis.** Oval, rounded, slightly convex, piceous black, glabrous, shining. Scutellum distinct. Elytra with a very fine sutural stria slightly visible from the middle to the tip. Length .5 mm.; .02 inch.

Enterprise, Florida. Smaller, or of the same size and form as *O. glaber*, but easily known by the distinct scutellum, and fine sutural stria. The elytra are very sparsely and indistinctly punctulate as in the preceding.

21. **Orthoperus elongatus.** Oblong-elongate, slightly convex, piceous, moderately shining. Scutellum distinct. Elytra with a very fine sutural stria effaced behind, but curving in front around the base and ending half way between the scutellum and the humerus; tips separately rounded, with the apex of the abodomen more prominent than in the other species. Length .5 mm.; .02 inch.

Tampa, Florida. Smaller and narrower than the other species, having much the form of *Ptilium.*

22. **Lathridius opaculus.** Elongate, blackish piceous, opaque. Antennæ one-half longer than the head. Prothorax slightly convex, wider than long, a little narrowed behind, sides rounded in front, subsinuate behind the middle, margin not reflexed; disc transversely impressed near the base. Elytra elongate-oval, one-fourth wider than the prothorax, striæ fine punctulate, interspaces flat, disc oblique and broadly impressed in front of the middle; sutural stria more deeply impressed behind the middle. Length 1.5 mm.; .06 inch.

Detroit, Illinois, Mass., and Maryland. In some specimens the prothorax is obsoletely channeled.

23. **Lathridius maculatus.** Less elongate, blackish piceous, opaque. Head and prothorax broadly channeled, the latter feebly convex, wider than long, narrowed behind, sides finely serrate, not reflexed, rounded in front, sinuate towards the base; disc deeply transversely impressed behind the middle. Elytra nearly one-half wider than the prothorax, truncate at base, widest just behind the middle, sub-depressed, striæ fine, punctured, sutural and two outer ones deeper, especially near the tip; color testaceous, tessellated with black quadrate spots, margin blackish; disc deeply obliquely impressed near the base. Length 1.9 mm.; .075 inch.

Detroit. Allied to these two species is the following:

24. **Lathridius duplicatus.** Moderately elongate, blackish piceous, opaque. Prothorax one-half wider than long, narrowed behind, sides finely serrate, rounded in front, oblique behind, hind angles obtuse; disc feebly impressed in front of the middle, and with a shallow transverse impression behind the middle. Elytra one-third wider than the prothorax, elongate-oval, striæ composed of punctures, not regularly arranged, and approximated by pairs; the sutural and two outer ones are slightly impressed near the tip. Legs rufo-piceous. Length 1.9 mm.; .075 inch.

Illinois, and Detroit. This and the two preceding species belong to the group *Enicmus* Thomson, in which the prosternum extends to the hind margin of the prothorax, the antennæ are shorter than the head and prothorax, with the three outer joints enlarged; and the prothorax is not strongly margined at the sides.

In *L. sculptilis* only two joints of the antennæ form the club; it thus belongs to *Coninomus* Thomson. In *L. liratus,* a still more remarkable peculiarity, first mentioned to me by Dr. Horn, is seen; the prosternum extends only a short distance behind the coxæ, and is enclosed by the epimera, which coalesce on the median line as in Rhynchophora; the front coxæ are also conical, prominent and contiguous. The antennæ are slender and longer than the head and thorax, as in the true *Lathridii* with costate prothorax. These differences in structure entitle it to be ranked as a distinct genus for which the name *Stephostethus* may be adopted.

The two following species belong to *Enicmus*, though the antennæ are more slender and a little longer than in those above described, and the sides of the prothorax are flattened.

25. **Lathridius tenuicornis.** Robust, depressed, dark brown, head and prothorax opaque, scabrous, slightly channeled. Prothorax more than one-half longer than wide, narrowed before and behind, sides strongly rounded, oblique towards the base, margin finely serrate, flattened but not reflexed; disc with a transverse slightly curved impression in front of the base, extending nearly to the sides. Elytra oval, wider than the prothorax, strongly margined, impressed near the base, shining; striæ scarcely impressed, finely punctured, interspaces flat, each with an obsolete row of very fine points. Antennæ shorter than the head and prothorax, slender, three outer joints longer, but very slightly thickened. Length 2 mm.; .08 inch.

California, near Sonoma.

26. **Lathridius laticollis.** Less robust, sub-depressed, brown, antennæ, legs and antennæ rufous. Head and prothorax opaque, scabrous, feebly channeled, the latter nearly twice as wide as long, formed and sculptured as in *L. tenuicornis*, but less rounded on the sides. Elytra elongate-oval, very little wider than the prothorax, truncate at base, strongly margined at the sides, slightly impressed near the base; striæ punctured, scarcely impressed, fainter behind; interspaces nearly smooth, flat. Antennæ two-thirds as long as the head and prothorax, slender, outer three joints a little thickened. Length 1.5 mm.; .06 inch.

Detroit. This species is very closely related to *L. tenuicornis*, and differs only by the prothorax being less rounded on the sides, and the elytra but little wider than it.

ODONTOSPHINDUS nov. gen. SPHINDIDÆ.

General characters as in *Sphindus*, except:

Body elongate, glabrous; sides of the prothorax but feebly rounded, with 6 or 7 distinct teeth; elytra with striæ not impressed but strongly punctured. Flanks of prothorax not concave for the reception of the antennæ. Antennæ, legs, tarsi and sterna precisely as in *Sphindus*.

This genus would seem to indicate a relation between the families Sphindidæ and Derodontidæ.

27. **O. denticollis.** Elongate, sub-cylindrical, brown, glabrous. Head finely punctured, transverse frontal impression deep, vertex, with a broad but not deep channel. Prothorax twice as wide as long, slightly narrowed in front, strongly but not coarsely punctured, sides nearly straight (♂), or slighthly rounded (♀), with 6 or 7 distinct teeth, hind

angles obtuse, base slightly rounded, very finely margined. Scutellum large, acuminate behind. Elytra nearly four times as long as the prothorax, but not wider; striæ not impressed, strongly punctured; scutellar stria long; behind the base there is a shallow impression. Antennæ paler at base, club large, two-jointed; eyes convex prominent. Length 2.7 mm.: .10 inch.

Detroit; one specimen. I am indebted to Dr. Horn for other specimens from Canada and California.

EURYSPHINDUS nov. gen. SPHINDIDÆ.

General characters as in *Sphindus*, except:

Body broadly oval, moderately convex, clothed with erect hairs; prothorax narrowed in front, rounded on the sides; elytra with striæ feebly impressed, strongly punctured. Flanks of prothorax deeply and widely concave beneath. Eyes small, frontal suture finely impressed, not deep.

28. **E. hirtus.** Blackish brown, shining, pubescent with stiff erect hairs. Head sparsely punctulate, frontal suture fine, eyes small, not prominent, but convex. Prothorax more than twice as wide as its length, narrowed in front, sides slightly flattened, edge acute, crenulate, scarcely margined, base sub-sinuate not margined, disc strongly not coarsely punctured. Scutellum large, finely punctured. Elytra with striæ of well marked punctures, interspaces feebly convex, rugosely punctulate; humeral callus rather prominent, paler brown. Beneath punctured, tibiæ and tarsi paler. Length 1.6 mm.; .06 inch.

Detroit; one specimen. In the Munich Catalogue *Sphindus* is placed at the end of the *Ptinidæ*, a position for which it is unsuited, on account of the much smaller coxal cavities the prosternum distinctly separates the coxæ, which are themselves, though transverse, small and not prominent. The form of the antennæ and tarsi also forbids a reference to the Ptinidæ. To these characters I have to mention, that the antennæ, in repose, are flexed in a different manner, the slender part being laid each side along the prosternal suture, and the club bent suddenly outwards, behind the front leg. In *Eurysphindus* the flanks of the prothorax are deeply concave for the reception of these organs, in *Sphindus* the concavity is much less; and in *Odontosphindus* the depression is obsolete, though the form of the antennæ is the same in all three genera. I may here observe that the club of the antennæ is described as three-jointed; the 8th joint is so much smaller than the 9th and 10th, and moreover, so little different in width and length from the 7th, that it seems more natural to view it as belonging rather to the stem than to the club, which would thus be properly designated as two-jointed.

MYCETOPHAGUS Hellw.*

The species known to occur in our fauna are eleven in number, three of which will now for the first time be described, two of these presenting characters worthy of special mention.

M. confusus departs remarkably in sculpture from the other species, to a degree that one of the generic characteristics becomes lost. There is no arrangement of punctures in striæ except very feebly at middle near the base, while the punctures of the intervals become so numerous and large that the punctuation becomes confused as in *Triphyllus*.

M. tenuifasciatus has a peculiar male sexual character, consisting of a transverse row of fine silken hairs on the first abdominal segment. No other species in our fauna has any other male character than that afforded by the anterior tarsi which are three-jointed, in the female four-jointed.

In the vast majority of our species the antennæ are either somewhat fusiform or gradually thickened to tip; two, however, have the last three joints of equal width and rather suddenly wider than the preceding. Other characters of less importance are made use of in the following synoptic table.

Table of species of MYCETOPHAGUS.

Elytra striato-punctate..**1.**
Elytra confusedly punctured..**6.**
1. Antennæ gradually broader externally or sub-fusiform..............**2.**
Antennæ with last three joints rather suddenly larger...............**5.**
2. Thorax broader at base...**3.**
Thorax narrower at base than at middle.............................**4.**
3. Abdomen moderately shining, punctuation less dense:
    Prosternum coarsely punctured. Antennæ longer than head and thorax..**punctatus.**
    Prosternum nearly smooth. Antennæ not longer than head and thorax..**californicus.**
Abdomen densely and finely punctured, sub-opaque.
    Prosternum nearly smooth at middle...................**flexuosus.**
    Prosternum densely and coarsely punctured.........**bipustulatus.**

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* For this synopsis of *Mycetophagidæ*, and the descriptions of the new species belonging to the family, I am indebted to the kindness of Dr. G. H. HORN.

4. Margin of thorax entire :
   Form rather broad, thorax densely and freely punctured.......... **pluriguttatus.**
   Form slender, thorax coarsely and deeply punctured **Melsheimeri.**
   Margin of thorax serrulate :
   Elytra maculate with yellow spots................**pluripunctatus.**
   Elytra piceous brown.....................................**pini.**
5. Elytra nearly black. Male with brush of hair on first ventral......... **tenuifasciatus,** n. sp.
   Elytra piceous, maculate with yellow. Male without brush........... **obsoletus,** n. sp.
6. Elytra maculate with large yellow spots..............**confusus,** n. sp.

With *Melsheimeri* I have united *obscurus*, the latter seeming to be merely an unicolorous form. *M. pini* and *pluripunctatus* would seem to occupy the above relationship, but the latter is always more slender and less depressed.

Of the above species *californicus* and *pluriguttatus* are peculiar to California, *confusus* to Colorado, *tenuifasciatus* extends across the north of our territory, while the other species are widely distributed in the Atlantic and Gulf States.

29. **Mycetophagus californicus** *Horn*, n. sp. Oval, piceous, feebly shining, sparsely clothed with brownish pubescence. Head moderately densely punctate. Antennæ brownish, base and terminal joint paler, the latter nearly as long as the two preceding. Thorax transverse, broadest at base, sides arcuate and gradually narrower to apex, margin not serrulate, surface moderately densely punctured with coarse and fine punctures, basal impressions moderately deep. Elytra nearly black, with a yellow oblique spot at the humeri, and a transverse fascia at apical third, not attaining the suture nor margin, surface with striæ of small sub-quadrate punctures not closely placed, intervals flat, irregularly biseriately punctulate. Body beneath and legs brownish, prosternum nearly smooth, abdomen finely but not densely punctulate. Length .16 inch ; 4 mm.

This species is of the same general form as *punctatus* but smaller. The elytral markings in the two species are of the same type but in the present the yellow color is less extended. The antennæ are not longer than the head and thorax. The abdomen of the male is simple, the first joint of the anterior tarsi slender and moderately long.

Two specimens, Lake Tahoe, California, Crotch.

30. **Mycetophagus tenuifasciatus** *Horn*, n. sp. Oval, piceous black, feebly shining, sparsely pubescent. Head moderately densely punctate. Antennæ piceous, last three joints broader. Thorax transverse, sides arcuate, margin not denticulate, base very slightly narrowed, disc densely punctured with coarse and fine punctures intermixed, those toward the sides coarse, basal impressions feeble. Elytra with striæ of moderate punctures rather closely placed, intervals finely biseriately punctulate. Abdomen

finely punctulate, sparsely at middle, more densely at the sides. Legs nearly black. Length .20 inch ; 5 mm.

In addition to the short black pubescence clothing the elytra there are very narrow sinuous bands of grayish pubescence, the first at basal third, the second behind the middle, and also an apical spot. The median band divides near the middle of each elytra and sends one branch forward, another backward to the margin. When the pubescence of the bands is removed the surface beneath is somewhat paler.

The punctuation of the surface of the thorax varies somewhat. In a specimen from Marquette, Mich., the entire surface of the thorax is as coarsely punctured as at the sides, and the elytral sculpture also stronger.

In addition to the anterior tarsi being three-jointed, the male has a tuft of silken hairs arising from an arcuate line at the middle of the first ventral segment.

Occurs from the White Mountains of New Hampshire to Michigan, Colorado and British Columbia.

31. **M. confusus** *Horn*, n. sp.

Oval, piceous, sparsely pubescent, elytra maculate with yellow. Head densely punctured. Antennæ as long as head and thorax, outer four joints stouter. Thorax transverse, arcuately narrowed from base to apex, surface densely and coarsely punctured, basal impressions moderately deep, margin not serrulate. Elytra densely punctulate with a feebly striate arrangement at middle near the base, color piceous, maculate with large yellow spots as in *flexuosus*, the posterior band, however, not attaining the apex. Body beneath and legs rufo-piceous, prosternum sparsely punctate, abdomen densely punctate. Length .18 inch ; 4.5 mm.

One ♀ specimen, Colorado, Morrison.

32. **Diplocœlus angusticollis** *Horn*, n. sp. Oblong-oval, piceous, moderately shining, sparsely pubescent. Head coarsely and moderately densely punctured. Thorax trapezoidal, narrowed in front, sides very feebly arcuate, hind angles suddenly broader covering the base of the elytra, surface coarsely and deeply punctured, with three feebly elevated lines at the sides which are less distinct in front. Elytra oblong-oval, with rows of coarse closely placed punctures, intervals with a single row of fine punctures, surface sparsely clothed with fine recumbent pubescence, with short, semi-erect, stouter hairs arising from the interstitial punctures. Abdomen alutaceous, sparsely punctate and finely pubescent. Length .13 inch ; 3.25 mm.

This is the only species described with the thorax much narrowed in front. Its aspect is somewhat that of a *Throscus*.

One specimen, Marquette, Mich.

It seems to me that the opinion of Mr. Reitter is correct that *Marginus* does not appear to be sufficiently distinct from *Diplocœlus* (Verhandl., k. k. Zool. Bot. Gesells. Wien, 1877, p. 189). We have in our fauna, by this arrangement, three species, of which the one above described is new. They are as follows:

Table of species of DIPLOCŒLUS.

Lateral lines of thorax well marked.
Thorax narrowed in front, sides nearly straight, hind angles prominent externally...**angusticollis.**
Thorax not narrowed in front, sides regularly arcuate..........**brunneus.**
Lateral lines of thorax obsolete....................................**rudis.**

D. brunneus *Lec.*, New species, 1863, p. 73, has the thorax equally wide at apex and base, and the lines at the sides of the thorax well marked. The elytra are slightly wider than the thorax and very sparsely clothed with a recumbent pubescence, the interstitial punctures bearing short semi-erect hairs. Length .14 inch; 3.5 mm.

Occurs from Pennsylvania to Illinois.

D. rudis *Lec.*, (*Marginus*) loc. cit; *philothermoides* Reitter, Verhand. k. k. Zool. Bot., Gesellsch. Wien, 1877, p. 189.

A much smaller species than either of the preceding, resembling at first glance a *Philothermus*. The thorax is rather broader than the elytra, coarsely and densely punctured, with a feeble trace of one of the lines only. The surface is pubescent as in *brunneus*. Length .08 inch; 2 mm.

In describing this species Mr. Reitter says the intervals are without fine punctures. They are nearly obsolete in some specimens but quite distinct in others.

D. mus Reitter, loc. cit., p. 188.

Under this name a species is described by Mr. Reitter, who is in doubt whether it came from "Amer. occ." or the West India Islands. It seems to be Mexican.

Table of species of LITARGUS.

The species may be distinguished in the following manner:

Terminal joint of antennæ oval, scarcely longer and never wider than the preceding..**1.**
Terminal joint of antennæ truncate at tip, usually longer and always wider than the preceding...**2.**
1. Club of antennæ rather loose; thorax rather finely punctured and depressed, basal impressions distinct................**1. sexpunctatus.**
Club of antennæ compact; thorax coarsely punctured, convex basal impressions obsolete......................................**4. didesmus.**

2. Form rather convex, elytra coarsely not densely punctate. Thorax without basal impressions.
   - Thorax more finely punctate than the elytra, the latter with the pubescence in distinct rows, last joint of antennæ not longer than the length.................................**3. tetraspilotus.**
   - Thorax as coarsely punctate as the elytra, the latter without any serrate arrangement of pubescence, last joint of antennæ notably longer than the length...........................**5. nebulosus.**

   Form depressed, elytra rather finely and densely punctate. Thorax with basal impressions.
   - Thorax densely punctulate, pubescence of elytra partly serrate, partly recumbent; last joint of antennæ nearly as long as the two preceding together...............................**2. balteatus.**

(1.) **L. sexpunctatus** Say, (*Mycetoph.*) Journ. Acad. V, 261; Lec. Proc. Acad. 1856, p. 14.

Piceous, depressed, moderately shining, each elytron with three yellow spots. Thorax sub-opaque, moderately densely punctate. Elytra densely punctate, shining, sparsely pubescent and with semi-erect hairs in rows. Length 2.75 mm.; .11 inch.

Pennsylvania, South Carolina, Illinois. This species and the next are the only ones with distinct basal thoracic impression and with a depressed form of body.

(2.) **L. balteatus** *Lec.*; *transversus* Lec.; *infulatus* Lec. Proc. Acad. 1856, p. 14.

The form, color and sculpture resemble the preceding species. The pubescence of the elytra is rather more evident while the seriated hairs are rather less distinct. The color of the elytra is piceous with yellow spots, as follows: one humeral, another post-scutellar, often united, a transverse band behind the middle angulated in front at the middle of each elytra. Length 2–2.75 mm.; .08–.11 inch.

The terminal joint of the antennæ is broader than the preceding, truncate at tip, and nearly as long as the ninth and tenth together.

Occurs from Missouri to Colorado, Arizona and California.

(3.) **L. tetraspilotus** *Lec.* loc. cit.

Oval, moderately convex, piceous, shining, sparsely pubescent. Antennæ with club rather loose, three-jointed, the last joint a little longer and broader than the preceding, and truncate at tip. Thorax less coarsely punctured than the elytra, intervals between the punctures alutaceous, basal impressions absent, basal margin rather suddenly sinuate on each side of the middle. Elytra rather coarsely and sparsely punctate, punctures vaguely arranged in rows, surface shining, color piceous, with two yellow spots on each side, one slightly in front of middle, the other larger, one-third from apex, hairs all semi-erect and in distinct rows. Length 2 mm.; .08 inch.

This species and *nebulosus* are the only ones in which a distinct sinuation occurs on each side of the middle of the base of the thorax.

Occurs from Pennsylvania to Georgia and Missouri.

(4.) **L. didesmus** *Lec.* loc. cit. p. 15.

Similar in form, color and sculpture to the preceding, and differing as follows:

Club of antennæ rather compact, three-jointed, the eighth joint, however, slightly wider than the seventh, terminal joint oval, not as wide as the preceding. Thorax rather coarsely punctate, not alutaceous, basal impressions wanting, basal margin squarely truncate. Elytra coarsely and moderately truncate, punctures not in striæ, pubescence partly erect not striate, color piceous, shining, each elytra with an oblique humeral yellow spot, another slightly behind the middle and also oblique, extending from the margin to the suture. Length 2.25 mm.; .09 inch.

The yellow markings vary somewhat in extent.

Occurs from Pennsylvania to Florida.

(5.) **L. nebulosus** *Lec.* loc. cit.

Resembles *didesmus* in form and sculpture. The antennæ are as in *tetraspilotus.* The thorax is as coarsely punctured as the elytra, and not alutaceous, basal impressions wanting, basal margin sinuate on each side of middle. Elytra coarsely punctate, pubescence partly semi-erect but not striate, the color is usually testaceous, with a piceous dentate band behind the middle, another one-third from apex. Length 1.5–2 mm.; .06–.08 inch.

This is our smallest species. It is usually of much paler color than the others, and the elytral markings are sometimes reduced to scattered piceous spots.

Occurs in the Middle States.

Table of species of TRIPHYLLUS.

Elongate, not convex; prothorax strongly margined at the sides....... **elongatus.**

Elongate-oval, convex; prothorax finely margined at the sides. .**ruficornis.**

33. **Rhizophagus brunneus** *Horn*, n. sp. Uniformly brownish, moderately shining. Head sparsely punctate. Thorax a little larger than wide, apex and base truncate, sides sub-parallel at middle, slightly arcuate at apex and base, disc convex, coarsely and sparsely punctured. Elytra slightly wider at base than the thorax, and feebly emarginate, disc with rows of moderately coarse punctures which become somewhat finer toward the tip. Prosternum coarsely punctured, side pieces nearly smooth. Metasternum smooth at middle. Abdomen coarsely and sparsely punctured, the first segment smooth at middle. Pygidium sparsely punctate. Length 3 mm.; .12 inch.

Marquette, Lake Superior. The punctures of the entire surface are coarser than in any other of our species. It must be considered the intermediate form between those with the long and those with the broad thorax.

34. **Pedilophorus subcanus.** Longer-oval, convex, rounded behind, obliquely narrowed in front of the elytra, black, irregularly mottled with very short gray pubescence like hoar frost, and thinly clothed with short erect black bristles. Beneath finely, densely punctured, finely pubescent, legs piceous; tarsi paler, fourth joint with a long lobe. Length 4.4 mm ; .17 inch.

Escanaba, Lake Superior. In form and pubescence this species resemembles *Byrrhus*, but the tarsal lobe requires its reference to the present genus, with which it also agrees in having the mandibles not covered by the prosternum in repose.

35. **Paromalus teres.** Cylindrical, but not slender, shining black ; head and prothorax punctulate, elytra finely not densely punctured, each with faint traces of two oblique striæ near the base ; sutural stria wanting. Pygidium very finely punctulate, under surface finely and sparsely punctured ; mesosternum emarginate in front, marked with a fine lateral line ; prosternum flattened without striæ. Length 2 mm ; .08 inch.

Sault St. Marie ; one specimen. This species only differs from *P. seminulum* by the cylindrical form, in which it deceptively resembles *Teretrius americanus;* by having the elytra more finely punctured, and by the entire absence of the sutural stria.

The following species may be conveniently described on the present occasion.

36. **Hetærius Blanchardi.** Oval-quadrate, brown, shining, of the same form as *H. brunneipennis*, sparsely pilose with long slender sub-erect yellowish hairs. Head opaque, finely punctulate, broadly concave. Prothorax with the sides slightly nicked at the middle, lateral lobes of the disc obsoletely punctulate, divided behind the middle by a transverse groove, hinder part deeply margined on both sides ; the impressed groove separating the lateral lobe from the disc is much deeper and broader at the base. Elytra with three very fine striæ, the inner one effaced behind the middle. Pygidium opaque, very finely and densely punctulate. Prosternum narrow, flat, densely punctulate, lateral edges well defined. Length 2 mm ; .08 inch,

Tyngsborough, Mass. Collected by Mr. Frederick Blanchard, to whom I dedicate it with much pleasure, as a mark of appreciation of his success in recovering many local species, which would otherwise have remained undetermined.

37. **Ægialia rufa.** Elongate, cylindrical, not very convex, rufous. Head finely scabrous, with an obsolete transverse impressed line; epistoma very finely margined, sub-truncate. Prothorax scarcely wider than long, sub-quadrate, sides very slightly rounded, fringed with stiff hairs, serrate towards the base, which is broadly rounded and distinctly margined; front angles prominent, hind angles rounded, disc coarsely sparsely punctured with some fine punctures intermixed. Elytral striæ deep, distinctly punctured, interspaces smooth. Scutellum small, smooth. Front tibiæ with three large teeth, middle and hind tibiæ gradually but moderately dilated, transverse ridges short; spurs of hind tibiæ long, hind tarsi two-thirds as long as the tibiæ. Length 4.5 mm; .175 inch.

Marquette, Lake Superior, two specimens; California, (precise locality unknown, probably from the Sierra Nevada), one example. The humeri in one Lake Superior specimen are prominent and tuberculate, in the other two rounded; in the former the spurs of the hind tibiæ, though not longer, are more slender than in the two with simple humeri. These differences are probably sexual, but cannot be fully investigated without more specimens.

For the easy recognition of our species of this genus I have enlarged the table given by Dr. Horn (Trans. Am. Ent. Soc., 1871, 293), as follows:

Table of species of ÆGIALIA.

Spurs of hind tibiæ long and slender..............................**2.**
Spurs of hind tibiæ flattened and broad; hind tibiæ gradually and moderately thickened, with two transverse ridges....................**3.**
Spurs of hind tibiæ long, thick, obliquely truncate; hind tibiæ gradually and very strongly thickened..............................**4.**
Spurs of hind tibiæ very short, cylindrical, hind tibiæ very strongly thickened..**5.**
2. Cylindrical, rufous, hind tibiæ with two transverse ridges..**1. rufa.** n. sp.
Sub-cylindrical, black, hind tibiæ serrate; elytral interspaces punctured..**2. cylindrica.**
Sub-cylindrical, black, hind tibiæ serrate; elytral interspaces smooth.. **3. lacustris.**
3. Prothorax finely punctured; black, sub-ovate..............**4. conferta.**
4. Robust, slightly ovate, black; prothorax coarsely punctured.......... **5. latispina,** n. sp.
Robust-ovate, black; prothorax coarsely punctured..........**6. crassa.**

5. Elongate-ovate, rufous, hind tibiæ with very short, thick cylindrical spurs .... 7. **spissipes**, n. sp.

38. **Ægialia latispina.** Robust, sub-ovate, convex, black, Head less finely scabrous, epistoma finely margined, sub-truncate. Prothorax more than twice as wide as its length, narrowed in front, rounded on the sides and fringed with stiff yellow hairs; sides impressed near the front angles, which are small; base not margined; disc coarsely sparsely punctured, without intermixed small punctures, sides nearly smooth, with the lateral fovæ large, as in *Æ. crassa*. Elytra with strongly punctured striæ, interspaces moderately convex. Scutellum small, convex at the middle. Front tibiæ with three large teeth, middle and hind tibiæ strongly and gradually thickened, with two long prominent transverse ridges; spurs of hind tibiæ long and thick, flattened and obliquely truncate as in *Æ. crassa*. Length 3.7 mm; .15 inch.

Mojave Desert, Mr. Crotch, two specimens. Allied to *Æ. crassa*, but differs by the less ovate body, and distinctly punctured elytral striæ.

39. **Ægialia spissipes.** Sub-cylindrical, sub-ovate, a little wider behind, rufous. Head finely scabrous, epistoma very finely margined, subtruncate in front. Prothorax one-half wider than long, not narrowed in front, rounded on the sides and fringed with stiff hairs; front angles prominent, hind angles rounded, base not margined; disc indistinctly rugoso-punctate. Scutellum small, bipunctate. Elytral striæ deep, slightly punctured, interspaces flat. Front tibiæ with two very large teeth and one small one; middle tibiæ gradually thickened sub-serrate, hind tibiæ conical, very much thickened, not serrate, spurs short and very thick, tarsi very short. Length 4.5 mm; .175 inch.

Marquette, Lake Superior; one specimen.

40. **Phausis inaccensa.** Elongate, gray, slightly pubescent. Prothorax wider than long, semicircularly rounded at the tip and sides, the latter strongly incurved at the base, hind angles dentiform, disc dark, convex, smooth, sides very widely flattened, scabrous, pale gray; near the apex are two large colorless transparent spots. Elytra reticulato-punctate, but less coarsely than in *P. reticulata*, with the longitudinal elevated lines very faint, sides rather strongly margined. Beneath densely punctured, gray, meso- and metasternum dirty testaceous; antennæ and legs gray. Length 6.8 mm; .25 inch.

Marquette; two ♂, one of which has been kindly sent me by Mr. Schwarz. This species is rather larger and a little less slender than *P. reticulata*, and is easily known by the entire absence of phosphorescent spots on the abdomen. I may here mention that a ♀ of the last named species in the collection of Dr. Horn has short elytra, much as in the ♀ of *Photinus* (*Gynaptera*) *scintillans*. This insect has a very strong resemblance to *Lamprohiza splendidula* of Europe, but is generically distinct by the longer antennæ, and by the small acicular twelfth joint of those organs. Specifically, it differs by the disc of the prothorax being smooth, the transparent spots more oval, not curved, and by the hind angles of the prothorax being greatly retracted.

Hadrobregmus linearis *Lec.* Pr. Ac. Nat. Sc. Phila. 1865, 232.

A very singular series of this insect was collected at Detroit. In two individuals, both antennæ have ten joints, that is to say there are five small joints between the rounded second joint and the first of the elongated joints. In one specimen the right antennæ has eleven, while the left has ten joints; this difference is produced by the division of the fourth joint into two parts. In another specimen the right antenna has ten, while the left has but nine joints; and it is again the fourth joint of the left that is divided, so as to form the fourth and fifth of the right, the distal part resulting from this division, or the fifth joint of the eleven-jointed antenna, is even a little wider than the fourth joint. It is thus apparent, that in this type of the Serricorn series, the increase of number of joints from nine to eleven is produced by a power of segmentation, or vegetative repetition residing in the fourth joint of the antenna.

Another inference from this series of specimens is that the nominal species of this genus may have been unduly multiplied, and that they must be defined by other than antennal characters. A renewed examination of the specimens in my collection, indicates that all the species recognized by me in the memoir above cited are valid, and easily distinguished by the characters there given.

41. **Xyletinus lugubris.** Oval, convex, blackish, piceous, dull with very fine dense punctuation, and very short pruinose pubescence. Prothorax more than twice as wide as its length, very convex, declivous near the base, narrowed in front, sides rounded, incurved near the base which is slightly bisinuate. Elytra strongly striate, scutellar stria long. Beneath black, finely punctulate. Length 2.5 mm.; .10 inch.

Marquette, Lake Superior. Found also in Massachusetts and Nebraska. This species is allied to *X. fucatus*, but is smaller and less robust, and easily known by the prothorax more convex transversely and more declivous towards the base.

Several specimens of *X. fucatus* were collected by Mr. Crotch at Calaveras, California, which only differ from those found at Lake Superior by the smaller size, darker color and less deep elytral striæ. The following species seems to differ by the much coarser pubescence, and by the sides of the prothorax not at all flattened.

42. **Xyletinus pubescens.** Oval, convex, piceous, opaque, with fine rugose punctuation, densely closed with rather coarse yellowish pubescence. Prothorax more than twice as wide as long, narrowed in front, rounded at the sides, which are not at all flattened, transversely convex, slightly declivous towards the base. Elytra with deep impunctured striæ, scutellar stria long, interspaces flat. Beneath densely punctulate and pubescent. Length 2.8 mm.; .11 inch.

Bosque Co., Texas; one specimen; Mr. G. W. Belfrage.

MICROMALTHUS n. g. LYMEXYLIDÆ?

Body elongate, head wide, with rounded, convex eyes; prothorax wider than long, narrowed behind, elytra a little shorter than the abdomen, substriate, smooth at the apex; resembling in miniature a narrow *Hydnocera*, but greatly differing by the antennæ, palpi and tarsi.

Antennæ shorter than the head and prothorax; 1st and 2d joints rounded, as wide as long; 3d small, 4–10th wider, and becoming gradually transverse, 11th oval, not wider than the 10th; inserted on the edge of the front, before the eyes, which are convex, prominent, rounded, not emarginate, and rather finely granulated. Maxillary palpi with the last joint moderately large, oval, pointed; labial similar but much smaller; gular sutures straight, widely separated. Prothorax transverse, without angles, narrowed behind, not margined on the sides. Legs rather long, slender, tibiæ without spurs, tarsi 5-jointed, as long as the tibiæ, joints 1–4 equal, not lobed, 5th as long as the others united, claws simple. Front coxæ, oblique, conical, prominent, contiguous at the apex; middle coxæ large, oblique, conical, not continuous, hind coxæ transverse, conical, prominent. Abdomen with six free and nearly equal ventral segments. Prosternal sutures not visible; side pieces of metathorax long and narrow.

No sexual difference can be observed in any of the specimens collected, two small spiculæ project from the tip of the abdomen in each of them.

43. **M. debilis.** Piceous, shining, antennæ, palpi and legs yellow, head smooth, front transversely depressed. Prothorax smooth, with a faint transverse impression. Elytra feebly scabrous, nearly smooth at the tip, striate except at base and tip. Beneath punctulate, slightly pubescent; two or three dorsal segments exposed. Length 2.2 mm.; .85 inch.

Detroit, in decomposing wood, August. I have referred this genus to Lymexylidæ on account of the resemblance of the antennæ and coxæ to those of *Hylecœtus*. In such a feeble and ill-developed form we should naturally expect the peculiar sexual characters seen in the palpi of the other genera to disappear.

44. **Phymatodes maculicollis.** Blackish, piceous, finely sparsely pubescent. Head and prothorax finely not densely punctured, the latter a little wider than long, rounded at the sides, rufous, with a broad black dorsal stripe. Elytra not wider than the prothorax, densely punctured. Beneath sparsely punctulate, prothorax rufous, legs piceous, coxæ and thighs (except at base) blackish. Front coxæ contiguous; mesosternum triangular, middle coxæ slightly separated. Antennæ slender, filiform, a little more than half as long as the body, 4th joint equal to 5th. Length 6.3 mm.; .25 inch.

Isle Royale, Lake Superior; but one specimen found.

45. **Typocerus sparsus.** Black, shining, pubescent with coarse black hair. Head rather finely punctured. Prothorax sparsely and coarsely punctured, margined at base and apex with golden hair. Elytra sparsely and coarsely punctured, punctures becoming finer towards the tips, which are dehiscent by the curvature of the suture; bidentate, the outer tooth longer than the sutural one; ornamented with a transverse yellow spot very near the base, and three transverse yellow bands extending from the side margin to the suture. Beneath punctulate, pubescent with yellowish gray hair. Antennæ (♀) two-thirds as long as the body, not serrate, sixth and following joints with an elongate depressed sensitive space, extending from base to tip or nearly so. Length 10 mm.; .40 inch.

Escanaba, Lake Superior. This species resembles in appearance *T. zebratus*, but is at once recognized by the sparse punctuation of the prothorax and elytra.

46. **Chlamys cribripennis.** Sub-quadrate, coppery bronze, of the same form and color as *C. assimilis*, from which it differs by the prothorax more shining, finely strigose, impunctured, with the dorsal elevation only obsoletely divided at the highest part. The elytra have the elevations similarly placed, but smaller, and the interspaces are very coarsely, but not densely punctured. The pygidium is less opaque, in fact, somewhat shining, and more deeply punctured, and without the shallow rounded impressions seen in that species. Antennæ fulvous, labrum black. Length 2.5 mm.; .10 inch.

Detroit; one specimen.

47. **Phyllotreta robusta.** Less elongate than usual, black with a greenish bronze lustre. Head punctured, vertex with a short, fine, longitudinal impressed line. Prothorax twice as wide as long, strongly punctured, slightly narrowed in front, sides rounded, base truncate, not margined. Elytra oval, wider than the prothorax, rounded on the sides, similarly punctured; pale yellow, with a wide sutural stripe narrowed near the base, and rounded behind at about one-fifth from the tip, where it ends; the side margin is blackish from the base nearly to the tip, and the color is a little wider about the middle; there are besides two spots on each elytron, one occupying the humeral callus, and attaining both the base and side

margin, the other at the middle and near the blackish lateral margin, though separate from it. Antennæ slender, more than one-half as long as the body, black, first three joints brown. Beneath black, tibiæ and tarsi piceo-testaceous. Length 2 mm.; .08 inch.

Detroit; one specimen. Quite different from any other striped species in our fauna, and representing the European *P. biguttata* Foudras. Alt. 251.

The adoption of the Kirbyan name ***Orchestris*** for this genus by Mr. Crotch (Proc. Ac. Nat. Sc. Phila. 1873, 65) in preference to ***Phyllotreta*** Foudras, seems to me inexpedient for the following reasons:

Kirby (Faun. Proc. Am. IV, 217), characterizes a sub-genus *Orchestris* by a very brief formula, which is applicable to several groups of the old genus *Haltica*, to which generic names are now affixed.

His sub-genus was evidently defined for the purpose of describing two striped species of large size now enrolled in *Disonycha* Chevr., but in order to make his volume (exclusively devoted to North American species), more intelligible to the English student, he casually observes that his sub-genus corresponds with section b. 1,*††, of Stephens, "of which *H. Nemorum* is the type."

Now while unwilling to dispute that ***H. nemorum*** is the type of Stephens' unnamed British group, it is quite apparent that the remark of Mr. Kirby indicates simply an error of judgment or observation in not perceiving the differences (if there be any), between his large American species, for which the sub-genus was established, and the small European species; and thus the sub-generic name belongs properly to the former group.

The name ***Orchestris***, therefore, unless it is dropped entirely in consequence of its heterogeneous limitation, can be used only to supplant ***Disonycha*** Chevr. (1844), and the present group must be known as ***Phyllotreta***, under which name it was first characterized by Foudras in 1860

48. **Chætocnema rudis.** Oval, convex, bronzed, not shining. Head finely punctured. Prothorax rather densely and strongly punctured, very little narrowed in front, sides slightly rounded, finely margined, base not margined. Elytra with rows of deep punctures, the inner ones slightly confused near the base; space between the scutellar stria and the suture irregularly punctured. Beneath punctured, tibiæ and tarsi brown. Length 1.8 mm.; .07 inch

Marquette, Lake Superior; one specimen. This species belongs in the table (ante. p. 419), after *cribrata*, from which it differs by the much less confused elytral striæ.

49. **Mycetochares gracilis.** Elongate, piceous-black, shining, finely and sparsely pubescent. Head punctured, front depressed, vaguely foveate. Antennæ nearly half as long as the body, piceous, base brown; 2d joint small, 3d a little longer than the 4th. Eyes convex, prominent. Prothorax wider than the head, wider than long, narrowed and much

rounded on the sides in front; strongly punctured, disc broadly longitudinally impressed behind, flattened and explanate at the hind angles, which are rectangular; impressed each side at the base, which is truncate and not margined. Elytra a little wider than the prothorax, parallel, striæ punctured, scarcely impressed; interspaces transversely sparsely rugose and finely punctured. Beneath shining, trunk finely punctured. Abdomen sparsely punctulate. Front coxæ separated by the prosternum, which is narrow and punctured. Length 5.5 mm.; .22 inch.

Marquette, Lake Superior; one specimen. This species is related to *M. bicolor*, but is quite different in the less deeply striate elytra, the more strongly punctured prothorax and the dark antennæ and legs.

For the pupose of more clearly defining several new species, my table (New Sp. Col. Smiths. 8vo., 138) may be expanded as follows:

Table of species of MYCETOCHARES.

1. Front coxæ separated by the prosternum............................2.
Front coxæ contiguous, cavities confluent............................9.
2. Prothorax as wide as the elytra, or nearly so............................3.
Prothorax at base narrower than the elytra............................6.
3. Pubescence long, rather dense, prosternum very narrow..............4.
Pubescence very fine, or wanting; elytra with red humeral spot not striate; antennæ palpi and legs more or less yellow..................5.
4. Dull ferruginous beneath, piceous above, prothorax strongly densely punctured..**1. rufipes.**
Black or piceous, prothorax finely punctured......**2. pubipennis** n. sp.
5. Prothorax very wide, sparsely punctulate...........**3. laticollis** n. sp.
Narrower, prothorax sparsely punctulate, elytra more strongly punctured, two inner striæ perceptible....................**4. Haldemani.**
Wider, prothorax less finely punctured, elytra strongly punctured, indistinctly striate.......................................**5. fraterna.**
6. Elytra with red humeral spot..7.
Elytra black, without spot..8.
7. Prothorax with three basal foveæ.........................**6. foveata.**
Prothorax with two basal foveæ.............................**7. tenuis.**
8. Elytral striæ deep, legs yellow.............................**8. bicolor.**
Elytral striæ less impressed, legs dark................**9. gracilis** n. sp.
9. Elytra black, without spots..10.
Elytra with red humeral spot; antennæ stouter and legs black......11.
10. Antennæ, legs and under surface ferruginous, last two ventral segments piceous; prothoracic margin not flattened...........**10. analis** n. sp.
Antennæ, legs and under surface piceous; prothoracic margin narrowly but strongly explanate........................**11. lugubris** n. sp.

11. Prothorax with margin not explanate..........................**12.**
    Prothorax as wide as the elytra, strongly punctured, sides narrowly but strongly explanate........................**12. marginata**, n. sp.
12. Prothorax wide, strongly punctured, much rounded on the sides, which are not explanate..................................**13. binotata.**
    Prothorax slightly narrower than the elytra, strongly punctured, sides not explanate.................................**14. longula**, n. sp.

In the Munich Catalogue *Mycetophila* Gyll. (1810), which antedates *Mycetochares* Latr. (1825), is adopted for this genus ; the former name was, however, pre-occupied by Meigen (1803), for a genus of Diptera, as is very properly mentioned by Lacordaire (Gen. Col. V., 507, note).

M. basillaris (Say) remains unknown. When found, it will be easily recognized by the scarcely punctured prothorax, with three posterior impressions, and the striate elytra having an oblique red spot like the species 3–5 of the table.

50. **Mycetochares pubipennis.** Dark brown, shining, rather densely clothed, especially on the elytra, with long brown pubescence. Head punctured, eyes more transverse and less prominent than in the other species; antennæ paler brown, rather stout, about half as long as the body. Prothorax one-half wider than long, scarcely narrowed in front, not densely nor strongly punctured, broadly longitudinally impressed at the middle of the base, and obliquely near the hind angles; sides moderately rounded, not explanate, base not margined. Elytra not wider than the prothorax, punctured; striæ punctured not impressed, nearly obliterated at the sides and behind. Beneath punctulate and finely pubescent, legs piceo-rufous ; prosternum extremely narrow between the front coxæ. Length 4.8 mm.; .19 inch.

California, at Tejon and San Diego. Easily known by the more transverse and scarcely prominent eyes, and very narrow prosternum.

51. **Mycetochares laticollis.** Elongate-oval, not convex, above black, shining, elytra each with an oblique red spot near the base ; sparsely pubescent. Head and prothorax sparsely punctulate, the latter fully twice as wide as long, widest at the middle, very much rounded on the sides, which are slightly explanate near the hind angles ; base extremely finely margined, with three broad shallow impressions, of which the middle one is nearly obsolete. Elytra a little narrower than the prothorax, not densely punctured, with very faint traces of striæ near the suture. Antennæ rather stout, under surface and legs testaceous-red ; palpi and large gular spot yellow. Length 6.3 mm.; .25 inch.

Pennsylvania; under bark of *Populus dilatata* in June; one specimen, Prof. S. S. Haldeman. I confounded this species formerly with *M. fraterna*, from which it differs by the much more finely and sparsely punctured head and prothorax.

52. **Mycetochares analis.** Elongate, black, shining, pubescent. Antennæ brown, slender, one-half as long as the body. Head and prothorax strongly rather densely punctured, the latter twice as wide as long, narrowed in front, rounded on the sides, which are not explanate ; base scarcely impressed, indistinctly margined near the hind angles. Elytra very little wider than the prothorax, punctured, striæ punctured, slightly impressed, nearly obliterated at the sides and behind. Beneath finely punctured, dull ferruginous, 4th and 5th ventral segments dark piceous. Front coxæ contiguous. Length 7.5 mm.; .30 inch.

Detroit; one specimen. Of the same size, form and sculpture as *M. binotata*, but differing by the absence of the humeral spot, and the different color of the antennæ, legs and under surface.

53. **Mycetochares lugubris.** More elongate, black, shining, pubescent. Antennæ dark brown, rather stout, one half as long as the body. Head and prothorax strongly punctured, the latter twice as wide as long, sides rounded, especially in front, side margin narrowly but strongly explanate behind the middle, depression extending some distance along the base, which is indistinctly margined ; there are three vague shallow basal impressions. Elytra a little wider than the prothorax, punctured, striæ rather strongly impressed. Beneath shining, sparsely finely punctured. Legs piceous. Front coxæ contiguous. Length 6.4 mm.; .25 inch.

Detroit ; one specimen. A similar one collected in Kansas by Prof. Snow, is slightly immature ; the color is brown, with the base of the antennæ and legs testaceous.

54. **Mycetochares marginata.** Elongate, of the same form as *M. binotata* but smaller, black, shining, pubescent. Antennæ rather stout, black. Head and prothorax strongly rather densely punctured ; the latter twice as wide as long, much rounded on the sides, especially in front, sides behind the middle narrowly but strongly flattened ; base with three very faint shallow impressions. Elytra very little wider than the prothorax, punctured, striæ punctured, scarcely impressed, marked with a red humeral rounded spot. Beneath shining, sparsely punctulate, tarsi piceous ; front coxæ contiguous. Length 5.2 mm.; .21 inch.

Marquette, Lake Superior ; one specimen.

55. **Mycetochares longula.** More elongate, of the same form and size as *M. gracilis*, black, shining, pubescent. Antennæ stout, black, half as long as the body. Head and prothorax strongly, somewhat rugosely punctured, the latter about one-half wider than long, narrowed in front, rounded on the sides, which are not explanate, with three faint shallow basal

impressions. Elytra a little wider than the prothorax, punctured, striæ punctured, slightly impressed, obsolete towards the sides; marked with a small rounded humeral spot. Beneath shining, finely punctured, legs entirely black; front coxæ contiguous. Length 6 mm.; .23 inch.

Detroit; June; one specimen.

56. **Canifa pallipennis.** Elongate, rugosely punctured, finely pubescent. Head and prothorax black, the latter more than twice as wide as long, hind angles nearly rectangular, basal impressions broad, distinct. Elytra pale testaceous. Beneath and legs testaceous, abdomen and antennæ darker; second and third joints of the latter small, united shorter than the fourth. Length 2.7 mm.; .10 inch.

Marquette, Lake Superior. Similar to *C. pusilla*, but with the head and prothorax darker, and the elytra pale.

57. **Dircæa fusca.** Elongate, fuscous brown, densely rugosely punctured, and clothed with short sericeous brown pubescence. Head perpendicular, more strongly punctured. Antennæ and palpi ferruginous, the former with third joint not longer than the fourth, following joints scarcely diminishing in length, longer than wide, eleventh longer. Prothorax a little longer than wide, apex rounded into the sides; hind angles obtuse, rounded at tip. Elytra with faint traces of three elevated lines. Beneath densely punctulate. Length 8.7 mm.; .34 inch.

Marquette, Lake Superior, Virginia and North Carolina. Larger than *D. concolor*, and easily known by the antennæ being ferruginous, and more slender, with the joints longer than wide.

58. **Hallomenus serricornis.** Elongate, rounded at each end, not convex, blackish, shining, finely densely punctured and pubescent. Antennæ scarcely longer than the head and prothorax, strongly serrate. Prothorax twice as wide as long, narrowed in front, strongly rounded on the sides, which are very finely margined; base slightly bisinuate, margined near the hind angles, basal impressions broad well-marked. Elytra faintly striate, but the striæ are not indicated by rows of punctures. Beneath finely and densely punctulate. Length 6.3 mm.; .25 inch.

Marquette; two specimens. Larger than our other species, and of uniform dark piceous, nearly black color, with strongly serrate antennæ.

Table of the species of HALLOMENUS.

Antennæ not serrate, joints sub-quadrate............................**2.**
Antennæ strongly serrate, joints triangular.........**1. serricornis** n sp.
2. Finely and distinctly punctured.......................................**3.**
Very finely punctured, yellowish brown, elytra in front and legs paler.......................................**2. punctulatus.**
3. Piceous, antennæ, legs and base of elytra testaceous......**3. scapularis.**
Pale brown, head fuscous, much smaller (3 mm.)..........**4. debilis.**

59. **Proctorus armatus** *Lec.* Rhynch. 212.

Several specimens of this curious insect were found at Marquette, and among them are ♂♂ in which the two processes of the apical edge of the last ventral segment are very short, and scarcely apparent, though the anterior tubercle or spine and the large excavation are as well developed as in the other specimens.

60. **Proctorus decipiens** *Lec.* ibid. 213, (*Encalus.*)

♂ Apical part of last ventral segment suddenly transversely depressed, with a short erect spine each side.

Marquette. The differences in the rostrum upon which I separated *Encalus* from *Proctorus*, are only sexual; and the peculiar ventral armature of the ♂ shows that they constitute but one genus.

61. **Orchestes canus** *Horn*,* n. sp. Black, sparsely clothed with grayish pubescence. Antennæ testaceous, funicle six-jointed. Thorax broader than long, apex one-third narrower than base, sides arcuate, disc coarsely punctured. Elytra oval, gradually narrowed posteriorly, disc convex, deeply and rather broadly striate, striæ with coarse, deep and closely placed punctures, intervals irregularly biseriately punctured, the punctures bearing short grayish hairs. Body beneath and legs black. Length 3 mm.; .12 inch.

The posterior femora are strongly thickened. This species cannot be confounded with any other than *pallicornis*, from which the deeply striate elytra, and very evident grayish pubescence will distinguish it.

Specimens are before me from Isle Royale and Escanaba, Michigan, and from San Juan, Colorado.

62. **Orchestes minutus** *Horn*, n. sp. Black, sparsely clothed with grayish pubescence. Antennæ piceous, scape and first joint of funicle paler, the funicle 6-jointed. Thorax broader than long, apex scarcely narrower than base, sides arcuate, surface coarsely punctured. Elytra oval, broadest at middle, disc slightly flattened, deeply striate, striæ with indistinct distant punctures, intervals wrinkled, irregularly, finely, biseriately punctulate. Body beneath and legs black. Posterior femora feebly thickened. Length 2 mm.; .08 inch.

This species resembles *rufipes*, but is somewhat smaller, disc of elytra flatter and with entirely black legs, and with the thorax much more arcuate at middle.

Four specimens, California, from Mr. James Behrens, collected probably near Sauzalito.

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* Dr. Horn has kindly prepared the table of this genus and the descriptions of the two new species.

Table of Species of ORCHESTES.

Funiculus of antennæ 6-jointed.
  Posterior femora much stouter than the middle.
    Legs entirely yellow.
      Pubescence of surface fulvous and conspicuous..........**puberulus.**
    Legs black, tarsi sometimes pale.
      Elytra feebly striate, pubescence scarcely evident.......**pallicornis.**
      Elytra deeply striate, pubescence grayish, persistent...**canus**, n. sp.
  Posterior femora scarcely stouter than the middle. Elytra deeply striate; species very small.
    Legs entirely black....................................**minutus**, n. sp.
    Legs yellow, posterior femora infuscate.................. ....**rufipes.**
Funiculus of antennæ 7-jointed.
  Pubescence above almost entirely black, a feeble grayish band at basal third. Scutellum densely white.........................**niger.**
  Pubescence above forming a somewhat saddle-shaped design in rather dense white pubescence ;
  Legs in part yellow, thorax broader at apex than long......**ephippiatus.**
  Legs entirely black, thorax not broader at apex than long....**subhirtus.**

With *O. niger*, I have united *parvicollis* Lec., of which I have now five specimens not essentially differing. The distribution is not remarkable (Nova Scotia to California) as *O. subhirtus* occurs also in California, while *O. pallicornis* extends from Nova Scotia to Texas, and to Puget Sound.

63. **Elleschus bipunctatus** *Linn* Faun. Suec. No. 599 (*Curculio*): Schönh. Curc. iii. 322; vii, 187: &c.

Detroit and Marquette. The European synonymy of this species may be found in the references given above. The differences between this genus and *Alyca* (Lec. Rhynch. 209), do not seem sufficient to warrant the retention of the latter. The species upon it was established, *Erirhinus ephippiatus* Say, differs from *bipunctatus* by finer punctuation, and pale yellow color, with a large sutural dark spot on the elytra. There are other species indicated by the specimens in my collection, but I do not feel prepared to define them accurately without a larger series.

64. **Acalyptus Carpini** *Herbst,* Col. vi, 204; pl. 74, f. 3; *Gyll.* Schönh. Curc. iii, 447: &c.

Michigan and Massachusetts; first known from Northern Europe. A small blackish insect, densely clothed with silvery gray sericeous pubescence, and easily known by the ventral sutures being straight the pygidium exposed, and the claws simple and divergent. The antennæ and legs are yellow ; sometimes the elytra are rufous, with the suture blackish.

65. **Zygobaris subcalva.** Of the same size and form as *Z. conspersa*, sub-rhomboidal, black, rather shining, thinly clothed with short pubescence, and without scales. Beak as long as the head and prothorax, curved, slightly thickened at the base, punctulate ; head finely punctate. Prothorax not wider than long, gradually narrowed in front, sides nearly straight, constricted near the tip ; surface densely, not coarsely punctured, base bisinuate. Elytra wider behind the base, humeri oblique, striæ deep, interspaces rather wide, flat, each with a row of small punctures. Beneath densely punctured, finely, sparsely pubescent ; claws small, approximate, but scarcely connate at base. Length 2 mm. ; .08 inch.

Detroit; one specimen found; I have two others from Pennsylvania. Differs from *Z. conspersa* chiefly by the finer punctuation, and the absence of scales.

66. **Pityophthorus annectens.** Elongate-cylindrical, brown, shining, with a very few slender erect scarcely serrate yellow hairs. Prothorax longer than wide, in front roughened almost concentrically for about one-third the length, sides and base finely sparsely punctured, punctures becoming larger, as they approach the roughened surface. Elytra with approximate rows of small punctures, interspaces transversely rugose ; apical declivity retuse, deeply impressed near the suture, which is elevated : sutural tip rather acute. Front tibiæ with two small teeth. Length 16 mm. : .06 inch.

♂. Head broadly concave, opaque with shallow punctures, concavity fringed with long yellow hairs.

♀. Head slightly convex, strongly and deeply punctured.

Tampa, Florida, on yellow pine ; Mr. E. A. Schwarz. This species is of slender form, and is most nearly allied to *P. nitidulus*, but is smaller, and has the prothorax more finely punctured. The color is also different, the Californian and Alaskan *nitidulus* being black, while this is always brown.

67. **Pityophthorus consimilis.** Yellow brown, shining, with a few erect yellow hairs, of the same form and sculpture as *P. annectens*, except that the obtuse elevation of the apical declivity of the elytra, and the corresponding part of the suture are sparsely crenate. The antennæ and legs are yellow, and the form is perhaps a trifle more robust. Length 1.6 mm. ; .06 inch.

♂. Head flat, slightly pubescent, with a large, sub-quadrate, densely punctured opaque spot occuping nearly the whole upper surface, and divided by a longitudinal impressed line ; sides shining, sparsely punctured.

♀. Head slightly convex, strongly punctured.

Marquette, Lake Superior, Detroit. The females of this and the preceding are undistinguishable, except by the characters given above; the ♂♂ are however easily recognized.

68. **Pityophthorus hirticeps.** Yellow brown, shining, cylindrical, less slender than the two preceding species, sparsely retose with fine, erect yellow hairs. Prothorax a little longer than wide, roughened concentrically for one-third its length; sides and posterior part strongly, rather densely punctured, with a narrow smooth median space. Elytra with approximate rows of punctures, interspaces irregularly transversely rugose; apical declivity retuse and crenate, deeply concave near the suture, which is elevated and also crenate. Length 1.6 mm.; .06 inch.

♂. Head broadly concave and opaque, fringed with long yellow hair.

♀. Head slightly convex, strongly punctured.

Marquette, Lake Superior. Related to the two preceding, agreeing with *P. annectens* in sexual characters, but with the crenations of the apical declivity of the elytra stronger than in *P. consimilis*, while the form is a little more robust than in either.

69. **Pityophthorus pusio.** Cylindrical, shining, piceous, with a few erect yellow hairs behind the middle of the elytra. Prothorax not longer than wide, roughened in front almost to the middle, strongly and densely punctured at the sides and behind, with a large, smooth, well-defined dorsal space. Elytra with small punctures, arranged in tolerably regular rows, apical declivity broadly concave, slightly retuse each side, with about three very small teeth; suture elevated, also with three or four slight inequalities. Front tibiæ with two very faint small teeth. Length 1.6 mm.; .06 inch.

Marquette, Lake Superior; one specimen. The head is retracted so that the front cannot be seen. This species is of the size and form of *P. pulicarius*, but the elytral sculpture and the apical declivity are quite different; it is more nearly related to the Californian *P. puncticollis*, but differs by the more robust form, and by the sparse crenations of the apical declivity, which are wanting in that species.

70. **Pityophthorus opaculus.** Cylindrical, slender, testaceous, head and disc of prothorax darker; anterior half rather strongly asperate, sides and posterior half sub-rugosely punctulate, dorsal line smooth, narrow. Elytra finely alutaceous, nearly opaque, marked with scarcely perceptible distant striæ of very fine punctures; apical declivity neither retuse nor concave, suture elevated, limited by a distinct striæ. Length 1.3 mm.; .05 inch.

Marquette; one specimen. This species must be placed after *P. comatus* in my table (Rhynch. 352). The head is punctured, and slightly convex, the legs and antennæ are yellow.

71. **Pityophthorus plagiatus**; *Xyleborus plagiatus* Lec., Tr. Am. Ent. Soc. 1868, 161; Rhynch 361.

Marquette; not rare. The club is transversely annulated, and it therefore belongs to *Pityophthorus;* the sexual differences indicate that *Xyleborus hamatus* Lec., Am. Ent. Soc. 1874, 72, is the ♀ of *carinulatus* Lec. ibid. (*Pityophthorus car.* Lec., Rhynch. 352).

72. **Pityophthorus sparsus.** *Xyleborus sparsus* Lec., Tr. Am. Ent. Soc. 1868, 160.

Marquette, Lake Superior; rare. This species, as is shown by the examination of well preserved specimens, has the club transversely annulated, and therefore belongs to *Pityophthorus.* There seems to be no sexual differences in the declivity of the elytra, but the ♂ has the head fringed with very long hair.

73. **Xyleborus punctipennis.** Slender, cylindrical, piceous, shining, thinly clothed with long erect yellow hair, granulato-asperate for more than one-half the length, sides and behind densely and coarsely punctured; smooth median line rather wide, very distinct. Elytra coarsely punctured, though not in altogether regular rows, suture elevated, and sutural stria deep for the whole length; declivity oblique, retuse, concave part coarsely punctured; there are two acute discoidal cusps, and several small indistinct marginal ones, the most anterior of which is near the suture and more prominent. Front tibiæ moderately dilated, bidentate. Length 2.5 mm.; .10 inch.

Marquette, Lake Superior; one ♀ specimen. This species might be easily confounded with *Pityophthorus sparsus,* but on comparison the difference in the antennal club is quite obvious; in the present case it is thicker, and obliquely truncate at tip, so that the proximal half at least is smooth and shining, and limited by a curved line. The punctures of the prothorax and elytra are coarser and more numerous, and the apical declivity is also punctured.

74. **Xylocleptes decipiens.** Slender, cylindrical, brown, shining, sparsely clothed with erect yellow hairs; antennæ and legs yellow. Prothorax longer than wide, slightly asperate in front with transverse rugosities; sides and behind coarsely but not densely punctured; median line and a smooth space each side well defined. Elytra ♂ coarsely punctured, punctures not arranged in rows; declivity nearly perpendicular, scarcely retuse, slightly impressed along the suture, which is feebly elevated. Head convex, finely punctured; front tibiæ moderately dilated, serrate with four or five very small teeth. Length 1.3 mm.; .05 inch.

Detroit; one specimen. This species greatly resembles in sculpture *Pityophthorus pulicarius,* but is more slender, and the antennal club is very different; the sutures are long curves, concentric with the apical margin, and the first joint is glabrous, shining and elliptical in form.

To this genus should be referred the Alaskan *Bostrichus concinnus* Mannh. Bull. Mosc. 1852, 358; *Tomicus conc.* Lec., Tr. Am. Ent. Soc. 1868, 164; Rhynch. 367. Only ♀♀ have thus far been collected.

75. **Tomicus balsameus.** Blackish piceous, or brown, cylindrical, shining, clothed with long erect yellow hairs. Prothorax longer than wide, asperate for about one-half the length, then strongly but not very densely punctured at the sides and behind; median space smooth, narrow, badly defined. Elytra with striæ composed of large rather distant punctures, interspaces with equally large but very distant punctures; declivity concave, sparsely not deeply punctured, margin with several small teeth and two large ones; the apical part of the margin is not a continuous ridge. Front tibiæ dilated, with four distinct teeth. Length 2.3 mm.; .09 inch.

♂ Head flat, shining, hairy with very long yellow hairs; the four larger teeth of the apical declivity less prominent.

♀ Head finely punctured; carinate with an acute elevated line; four larger teeth of apical declivity very prominent.

Central New York, where it has seriously injured the forests of *Abies balsamea*. For an account of the ravages of this insect see the Report of the Botanist in the 28th Annual Report of the New York State Museum of Natural History, 1874, p. 32–38. I am indebted to Mr. J. A. Lintner, of the State Museum, at Albany, for a series of specimens. Some care will be necessary to distinguish this insect from *Xyleborus punctipennis*, but apart from the differences of the anntenal club, the prothorax of *T. balsameus* is less densely punctured, the striæ are more distinctly formed, and the apical declivity is less punctured, with the teeth (♀) more prominent, and not distinctly separated from the elevation of the margin of the declivity. The front tibiæ are more distinctly toothed. The sutures of the club are straight and transverse, so that it belongs to the division *Orthotomicus* Ferrari, and may be placed in the table (Rhynch. 363), after *latidens*, to which it has no resemblance.

76. **Micracis opaciollis.** Slender, cylindrical, dirty testaceous. Prothorax darker, opaque, finely asperate in front, indistinctly punctulate, thinly sprinkled with very small ochreous scales. Elytra shining, punc-

tured in rows, interspaces with rows of very short stout bristles. Eyes extending to the under surface of the head, not widely but distinctly separated beneath. Club of antennæ with broadly curved sutures. Length 1.7 mm.; .07 inch.

♂. Scape of antennæ fringed with very long hair; (front not visible, the head being retracted).

Detroit; one specimen. To be placed in the table, (Rhynch. 368), before *M. rudis.*

77. **Micracis asperulus.** Slender, cylindrical, black, entirely opaque. Head not concave, scarcely punctured. Prothorax more strongly asperate in front than in the preceding, scarcely punctured behind, sprinkled with small yellowish scale-like hairs. Elytra obsoletely striate, densely rugosely punctured, interspaces with rows of very short stout bristles as in *M. opacicollis.* Eyes very narrowly separated beneath. Antennæ ferruginous, club with broadly curved sutures. Legs ferruginous. Length 1.7 mm.; .07 inch.

♂. Scape of antennæ fringed with very long hair.

Detroit; in dead oak twigs. Of the same size and form as the preceding, but quite different in sculpture.

78. **Scolytus unispinosus** *Lec.* Rhynch. 372.

Marquette, Lake Superior; one specimen. This differs from the two specimens from Oregon upon which the species was established, by the punctures of the elytra being not so small, and by the spine of the first ventral segment being much less developed, becoming in fact a small tubercle; the elytra are fringed with brown. I consider none of these as specific characters.

79. **Scolytus rugulosus** *Ratzeburg,* Ins i, 230; pl. x f. 10.

This is a suitable opportunity to notice the introduction of this European species into the United States. I have received specimens from Elmira, N. Y., where it attacks peach trees. According to Ratzeburg it is rare in Germany, but is found upon plum and apple trees.

80. **Choragus Harrisii.** Elongate-oval, sub-cylindrical, blackish-brown, shining, finely pubescent. Prothorax finely less densely punctured, not opaque; elytra with deep coarsely punctured striæ, interspaces not wider than the striæ, scarcely punctulate. Length 1.2 mm.; .05 inch.

Detroit; August; one specimen. Differs from our other two species by being more distinctly (though very finely) pubescent and by neither the prothorax nor elytra being opaque.

2. *List of* COLEOPTERA *found in the Lake Superior Region.*

BY H. G. HUBBARD AND E. A. SCHWARZ.

Abbreviations of Localities:

B. Bachewauung Bay.
E. Escañaba.
EH. Eagle Harbor.
I. Isle Royale.
LP. La Pointe.
M. Marquette.
Mi. Michipicoton Island.
Mr. Michipicoton River.
P. Pointe aux pins.
S. Sault de Ste Marie.
*. Species found by Dr. LeConte, mostly catalogued in Agassiz' Lake Superior, p. 203—239, which have not since occurred.

CICINDELIDÆ.

Cicindela longilabris Say. E.S.M.T.
patruela Dej. M.
purpurea Ol. E. M.
tranquebarica Hbst.
12-guttata Dej. Mi.

repanda Dej. E. M.
hirticollis Say. E. H. M.
punctulata Fabr.

CARABIDÆ.

Omophron americanum Dej. M.
tesselatum Dej. M.
Elaphrus olivaceus Lec. E.
Clairvillei Kby. E. M.
fuliginosus Say. E.
riparius Linn. M.
ruscarius Say.*
Blethisa multipunctata Linn. E.
quadricollis Hald. E. M.
Loricera cærulescens Linn. M.
Notiophilus æneus Hbst. M.
sibiricus Mots. M.
Nebria Sahlbergi Fisch. T. Mi. Mr.
suturalis Lec.* Black Bay.
pallipes Say.* M.
Calosoma scrutator Fabr. E.
frigidum Kby. M.
calidum Fabr. T.
Carabus serratus Say.*
sylvosus Say.*
tædatus Fabr. var.*
Cychrus Lecontei Dej. Mr. B. (fragments.)
Nomaretus bilobus Say. M. Mi.
Clivina americana Dej.*
Dyschirius nigripes Lec.*
æneolus Lec. M. T.
longulus Lec.*
globulosus Say. E.M.Mr.
sphæricollis Say. M.
brevispinus Lec.n.sp.M.
Casnonia pensylvanica Linn. M.
Loxopeza tricolor Say. E.
Aphelogenia furcata Lec.* EH.
Lebia pulchella Dej.* M.
pleuritica Lec.* EH.
viridis Say. E. M.
var. moesta Lec.* Mr.
pumila Dej. S.
ornata Say. M.
fuscata Dej.* Eagle Harbor.
Dianchomena scapularis Dej. M.
Dictya divisa Lec.* (*Lebia*): EH.
Aphelogenia furcata Lec. M.

Dromius piceus Dej. M. I.
Apristus subsulcatus Dej.*
Metabletus americanus Dej.
Blechrus linearis Lec.*
Cymindis cribricollis Dej. E. S. B.
Callida smaragdina Dej. E. M.
Rhombodera pallipes Lec. B.
Calathus ingratus Dej.
gregarius Say.*
mollis Mots. G. Mr. Mi. I.
impunctatus Say. P. Mi. M.
Platynus tenebricosus Gemm. M. Mi
decens Say. E. Mi. M.
sinuatus Dej. S. M.
marginatus Lec.*
ternuicollis Lec.*
anchomenoides Rand. M.
extensicollis Say.*
decorus Say.*
molestus Lec. S. M.
melanarius Dej. M. Mr.
metallescens Lec. M.
tenuis Lec. M.
carbo Lec. E. M.
mutatus Gemm. E. M.
cupripennis Say. S. M.
æruginosus Dej. E. I.
subcordatus Lec. E.
cupreus Dej. S.
ruficornis Lec. M.
lutulentus Leconte M. ; black var.
picicornis Lec. S. M. B.
sordens Kby.
picipennis Kby.*
lutulentus Lec. E. M.
nigriceps Lec. M.
obsoletus Say.
bembidioides Kirby.*
octocolus Mannh.
Olisthopus parmatus Say.* P. M.
Pterostichus adoxus Say.*
honestus Say.*
coracinus Newm. B. Mi.
stygicus Say.*
punctatissimus Rand. I. Mi.
Pterostichus Sayi Brullé.*
corvinus Dej.*
caudicalis Say.
lucublandus Say. S. M.
convexicollis Say.* S.
luctuosus Dej. E. M.
mutus Say E. M.
Luczotii Dej.
erythropus Dej. S.
patruelis Dej.* EH.
mandibularis Kby. var. M. Mr. I.
Myas foveatus Lec.* EH.
Amara arenaria Lec. M.
avida Say. S.
elongata Lec. M.
latior Kby. E. Mr. I.
septentrionalis Lec. E. M.
angustata Say. M.
pallipes Kby. S.
impuncticollis Say. M. I.
fallax Lec. M.
polita Lec. E. M.
erratica St. E. M. Mi. Mr.
interstitialis Dej. M.
obesa Say. E. S. M.
gibba Lec. E. M. B.
subænea Lec. E. M. B.
musculus Say. M.
Badister micans Lec. E.
obtusus Lec. n. sp. M.
Diplochila laticollis Lec. E.
var. **major** Lec. E.
Chlænius sericeus Forst. E. M.
nemoralis Dej.*
pensylvanicus Say. E. Mr.
cordicollis Kirby.*
impunctifrons Say. E.
niger Rand. E. M.
tomentosus Say. E.
Brachylobus lithophilus Say. M.
Anomoglossus emarginatus Say. E
pusillus Say. E.
Lachnocrepis parallela Say. E.
Miscodera americana Mann. G.
Nomius pygmæus Dej. M.

Psydrus piceus Lec.* EH.
Geopinus incrassatus Dej. E. M. Mr.
Agonoderus comma Fabr.
pallipes Fabr. Mr.
partiarius Say. M.
Anisodactylus agricola Say. E. M.
Harrisii Lec. M.
discoideus Dej. M.
baltimorensis Say. E. Mr.
sericans Harr. E.
Spongopus verticalis Lec. E.
Anisotarsus terminatus Say. Mr.
Bradycellus badiipennis Hald* EH.
nigrinus Dej. M. Mi.
cognatus Gyll. M. Mi. S.
cordicollis Lec. M. I.
rupestris Say. M.
Selenophorus opalinus Lec. E. M.
Harpalus compar Lec. Mr.
megacephalus Lec. M. I.
fulvilabris Mannh. M. Mr. I.
pleuriticus Kby. E. S. M.
herbivagus Say. E. M.
opacipennis Hald. M.
innocuus Lec. M.
rufimanus Lec. E. M. I.
Lewisii Lec. E. M.
laticeps Lec. E. M. I.
basilaris Kby. M.
Stenolophus carbonarius Dej.*
fuliginosus Dej M.
ochropezus Say.*
conjunctus Say. E. M.
carus Lec. E. S. Mr.
Patrobus longicornis Say. E. I.
tenuis Lec. Mr. M. E.
Trechus micans Lec.
Amerizus oblongulus Mannh. M.
Bembidium impressum Fabr. M. Mr.
paludosum Sturm. M. Mr.
coxendix Say.*
antiquum Dej. Mr.
chalceum Dej. M. Mr.
salebratum Lec.* L. P.
nitidum Kirby.*
concolor Kby. Mr. I.
Bembidium longulum Lec. Mr.
nigrum Dej.*
planatum Lec. I.
tetraglyptum Mannh. M.
simplex Lec. M. Mr.
fugax Lec.* North shore.
transversale Dej. M. Mr. I.
lucidum Lec. S. M. Mr.
rupestre Dej.*
scopulinum Kby.
picipes Kby.*
nitens Lec. Mr.
arcuatum Lec. n. sp. M.
versutum Lec. n. sp. M.
patruele Dej. M. Mr. I.
versicolor Lec.
sulcatum Lec. S.
affine Say. Mr.
anguliferum Lec. M.
cautum Lec. var. M.
mutatum Gemm. M.
axillare Lec.* S.
Tachys nanus Gyllh. B.
incurvus Say. E. M.

HALIPLIDÆ.

Haliplus borealis Lec. E.
cribrarius Lec. M.
ruficollis Degeer.*
longulus Lec.*
Cnemidotus edentulus Lec. E

DYTISCIDÆ.

Hydrovatus cuspidatus Germ.*
Hydroporus inæqualis Fab. M. B.
picatus Kby.*
impressopunctatus Sch. E. B.
dissimilis Harris.*
suturalis Lec.*
lacustris Say. B.
affinis Say. B.
fuscatus Crotch.*
scitulus Lec. Mr.

- **Hydroporus consimilis** Lec.*
  - **sericeus** Lec.*
  - **griseostriatus** Degeer.*
  - **rotundatus** Lec. B.
  - **alpinus** Payk.* North Shore.
  - **subpubescens** Lec. M. B. Mr.
  - **puberulus** Mannh. B.
  - **tenebrosus** Lec. M. B.
  - **tartaricus** Lec.*
  - **caliginosus** Lec. M.
  - **vilis** Lec. M.
  - **tristis** Payk.
  - **notabilis** Lec.* North Shore.
  - **collaris** Lec. B.
  - **persimilis** Cr. P. Mr.
  - **oblitus** Aubé. P. Mr.
  - **conoideus** Lec. M. E.
- **Laccophilus maculosus** Germ. B.
  - **proximus** Say.*
  - **atristernalis**? Cr. M.
- **Graphoderes cinereus** Linn. M.
  - **liberus** Say.*
- **Hydaticus piceus** Lec. E.
  - **stagnalis** Fab. E. M.
- **Scutopterus angustus** Lec. M.
- **Colymbetes sculptilis** Harr. E. B.
- **Dytiscus Harrisii** Kby.*
  - **confluens** Say. M.
  - **Cordieri** Aubé.* Nth Sh.
  - **fasciventris** Say. M.
  - **verticalis** Say.* Nth Sh.
- **Rhantus binotatus** Harr. E. B.
  - **flavogriseus** Cr. M.
  - **bistriatus** Bergstr.*
  - **sinuatus** Lec. M.
- **Ilybius confusus** Aubé. M.
  - **picipes** Kby. E. M.
  - **biguttulus** Germ. M.
  - **fraterculus** Lec. M.
  - **ignarus** Lec. E. M.
- **Coptotomus interrogatus** Fabr. E.
- **Copelatus Cherrolatii** Aubé.* EH.
- **Ilybiosoma bifaria** Kirby.* EH.
- **Gaurodytes erythropterus** Aubé.*
- **Gaurodytes ovoideus** Cr. E. Mr.
  - **semipunctatus** Kirby.*
- **Gaurodytes lutosus** Cr. M.
  - **leptapsis** Lec. n.sp. M.
  - **parallelus** Lec. M.
  - **infuscatus** Aubé.*N. Sh.
  - **scapularis** Mannh. M. B
  - **longulus** Lec. n.sp. M.
  - **obtusatus** Say.*
  - **punctulatus** Aubé.*
  - **fimbriatus** Lec. M.
  - **gagates** Aubé.*

GYRINIDÆ.

- **Dineutes assimilis** Aub. M.
- **Gyrinus confinis** Lec. M. B.
  - **fraternus** Coup. S. B.
  - **limbatus** Say. M. B.
  - **æneolus** Lec. S. B.
  - **dichrous** Lec. M. B.
  - **ventralis** Kby. B.
  - **aquiris** Lec. E. B.
  - **maculiventris** Lec. S. B.
  - **affinis** Aub. S. B.
  - **picipes** Aub. M. B.
  - **lugens** Zimm. M.
  - **analis** Say. S.
  - **pectoralis** Lec. S.

HYDROPHILIDÆ.

- **Helophorus oblongus** Lec.* EH.
  - **locustris** Lec. M.
  - **nitidulus** Lec.* EH.
  - **lineatus** Say. M.
  - **inquinatus** Mannh. S. M.
  - **tuberculatus** Gyll. S. M.
  - one unnamed species.
- **Hydrochus scabratus** Muls.*
  - **squamifer** Lec. M.
  - **rufipes** Mels.*
- **Ochthebius cribricollis** Lec.* EH.
  - **nitidus** Lec.* EH.
- **Hydræna pensylvanica** Ksw. S. M.
- **Hydrophilus triangularis** Say. E.
- **Tropisternus nimbatus** Say. B.
  - **glaber** Hbst. E.

Tropisternus mixtus Lec. E.
Hydrocharis obtusatus Say. E.
Laccobius agilis Rand. M.
Chætarthria pallida Lec.* EH.
Philhydrus bifidus Lec. M.
ochraceus Melsh. B. M.
consors Lec. E.
cinctus Lec. E.
perplexus Lec. M. B.
fimbriatus Melsh. E. S. B.
Hydrobius fuscipes Linn. E. M. B.
tesselatus Ziegl. M.
digestus Lec. M. I.
subcupreus Say.
Cercyon flavipes Er. M.
centromaculatum St. M.
ocellatum Say. B.
anale Er. M.
one unnamed species. M.
Cryptopleurum vagans Lec. M. S.

TRICHOPTERYGIDÆ.

Ptenidium sp. M. G. B. Mi.
Ptilium canadense Lec. M. B. Mr.
Trichopteryx several unnamed sp.
Pteryx brunnea Lec. S. M.
testacea Lec. M.
Ptinella quercus Lec. B.

STAPHYLINIDÆ.

(**Aleocharini** not determined.)
Gymnusa brevicollis Grav. M.
variegata Kiesenw. M.
one new species. M.
Dinopsis americana Kr. M.
Tachinus memnonius Grav. B. Mr.
tachyporoides Horn. M. B.
repandus Horn. M.
addendus Horn. M. B.
luridus Er. S. B.
picipes Er. M. B.
fumipennis Say. M. I.
frigidus Er. B. G. Mi.
circumcinctus Mkl. M. Mi.
Tachinus nitiduloides Horn.*
Leucoparyphus silphoides Linn.*
Tachyporus jocosus Say.
chrysomelinus Linn.
nanus Er. M.
brunneus Fab.
Erchomus ventriculus Say. M. B.
Conosoma littoreum Linn. M.
Knoxii Lec. B.
crassum Grav. M.
basale Er. M.
Bolitobius dimidiatus Er. M.
intrusus Horn. M.
cingulatus Mannh. I.
cincticollis Say. S. B. I.
anticus Horn. B. Mi.
pygmaeus Fab. S. Mi.
trinotatus Er.*
obsoletus Say. M. B. Mi.
cinctus Grav. Mi.
longiceps Lec. Mi.
Bryoporus rufescens Lec. M.
Mycetoporus lepidus Grav. S. G. Mr.
tenuis Horn. B. Mr.
consors Lec. M. B. Mi.
americanus Er.
pictus Horn. M.
Habrocerus magnus Lec. n. sp. M. I.
Acylophorus pronus Er. E. M.
Euryporus puncticollis Er. M.
Heterothops n. sp. M. B.
Quedius lævigatus Gyllh. M. G. I.
capucinus Grav. M.
sublimbatus Mots. Mr.
ænescens Mkl. Mr.
molochinus Grav. B. G. Mr. M.
4 undetermined species.
Staphylinus vulpinus Nordm. E.
Lecontei ✝ Fauv. M.
Philonthus cyanipennis Fab. B.
blandus Grav. M.
debilis Grav.
lomatus Er. E. S. M.
aterrimus Grav.
sobrinus Er. M.
pæderoides Lec. M.
several unnamed species.

Xantholinus cephalus Say. S.
obsidianus Melsh. M.
emmesus Grav. var.? P.
Baptolinus macrocephalus Nordm. Mi.
Lathrobium grande Lec.*
punctulatum Lec. E. M. I.
simile Lec. B.
nigrum Lec.
concolor Lec.* N. Sh.
longiusculum Grav.*
collare Er. E.
Scopæus sp. E.
Lithocharis confluens Say. M.
Pæderus littorarius Grav. M. S.
Dianous chalybeus Lec. M.
Stenus semicolon Lec. E.M.B.Mr.I.
Juno Fabr. E. M.
stygicus Say. M. Mr.
egenus Er. E. M.
flavicornis Er. E. M.
annularis Er. E.
punctatus Er. M. Mr.
several undescribed species.
Euæsthetus americanus Er. E. M.
Oxyporus rufipennis Lec. M.
stygicus Say. M.
vittatus Grav. M. B.
Bledius fumatus Lec. E.
annularis Lec. M.
confusus Lec. M.
ruficornis Lec. M.
divisus Lec. Mr.
tau Lec. M.
Platystethus americanus Er. M.
Oxytelus sculptus Grav. M.
fuscipennis Mannh. M. Mr.
nanus Er. M.
Apocellus sphæricollis Say. E. M.
Trogophlœus quadripunctatus Say. M. Mr.
several unnamed species.
Thinobius fimbriatus Lec. E.
Ancyrophorus planus Lec. I.
Syntomium confragosum Mkl. M.
Anthophagus verticalis Say. M. I.
Lesteva biguttula Lec. M.P.Mr Mi.
Acidota seriata Lec. M. Mr. I.
subcarinata Er. M.
patruelis Lec. Mr.
tenuis Lec.*
n. sp. Mi.
Arpedium sp. M. I.
sp. S. Mr.
Olophrum marginatum Mkl. S. P. M.
convexicolle Lec. M. Mr.
n. sp. S. P. Mr.
Porrhodytes brevicollis Mkl. Mr.
Omalium (Phlœostiba) Argus Lec. G. M.
5 unnamed species.
Pycnoglypta lurida Gyll. B. Mr.
Anthobium several sp.
Protinus parvulus Lec. B. Mr.
basalis Mkl. B. Mr.
Megarthrus excisus Lec. B.
Olisthærus megacephalus Zett. Mi. I.
nitidus Lec. I.
Siagonium americanum Melsh. M.
Pseudopsis sulcata Newm. M. P. B. G.
Micropeplus tesserula Curt. M.
laticollis Mkl. Mr.

PSELAPHIDÆ.

Tyrus humeralis Aubé.*
Pselaphus Erichsonii Lec. S. P.
Tychus longipalpus Lec. M. I.
Bryaxis conjuncta Lec. M.
propinqua Lec. M.P.Mi.I.
Decarthron longulum Lec.*
Batrisus globosus Lec. M. B.

SILPHIDÆ.

Necrophorus obscurus Kby. M.
orbicollis Say.*
vespilloides Hbst. E. Mi. I.
Silpha surinamensis Fabr. G.
lapponica Hbst. E. M.
inæqualis Fabr.*

Silpha americana Linn. G.
Catops opacus Say.*
brunneipennis Mannh. S. I.
terminans Lec. B. Mi. I.
Colon dentatum Lec. Mr.
magnicolle Mkl. ? M. Mr.
three unnamed species.
Hydnobius substriatus Lec. Mr.
Anisotoma assimilis Lec. M. Mr. I.
punctostriata Kby. M. Mi.
collaris Lec. Mr.
strigata Lec. M.
Cyrtusa picipennis Lec. M.
Liodes globosa Lec. M. I.
polita Lec. M.
discolor Melsh. M.
basalis Lec. M.
Agathidium globatile Lec. n.sp. M.
exiguum Melsh. M. B.
revolvens Lec. I.
politum Lec. B. Mr.
difforme Lec. M.
parvulum Lec. n.sp. M.
Clambus gibbulus Lec. M. I.

BRATHINIDÆ.

Brathinus nitidus Lec. M.
varicornis Lec. M. B. Mr.

SCYDMÆNIDÆ.

Scydmænus subpunctatus Lec. Mr.
n. sp. near **subpuntatus.**, Mr.
sp. near **analis.** S.
analis Lec. ? M.
clavipes Say. S.
fulvus Lec. M.
Euthia scitula Mkl. M.

CORYLOPHIDÆ.

Orthoperus scutellaris Lec. n. sp. S. Mr.
Sacium lugubre Lec. M.
obscurum Lec. M.
Sacium fasciatum Say. Mr.

SCAPHIDIIDÆ.

Scaphidium 4-guttatum Say. M.
Scaphium castanipes Kby. B. G. Mr. I.
Scaphisoma convexum Say. M. B.
suturale Lec. M.
terminatum Lec. M.

LATHRIDIIDÆ.

Lathridius liratus Lec. I.
minutus Linn. I.
cordicollis Mannh. ? M.
Corticaria grossa Lec. M.
serricollis Lec. Mr. I.
dentigera Lec. M. Mi.
deleta Mannh.
rugulosa Lec. M.
americana Mannh. S. M. G.
cavicollis Mannh. S. M. Mr.
pumila Melsh. M.
three unnamed species.

ENDOMYCHIDÆ.

Lycoperdina ferruginea Lec. B. I.
Mycetina perpulchra Newm. M.
vittata Fabr. M.
Endomychus biguttatus Say. S.

MYCETOPHAGIDÆ.

Mycetophagus flexuosus Say. E.
obsoletus Lec. var.? M.
tenuifasciatus Horn, n.sp. M.
pluripunctatus Lec. M.
Diplocœlus angusticollis Horn, n. sp. M.
Litargus tetraspilotus Lec. M.
6-punctatus Say. M.

SPHINDIDÆ.

Sphindus americanus Lec. M.

CIOIDÆ.

Cis creberrimus Mell. M. I.
Cis brevisetosus Cr. M.
fuscipes Mell. M.
three unnamed species.
Ennearthron sp. M.

EROTYLIDÆ.

Triplax macra Lec. M.
thoracica Say M.

CRYPTOPHAGIDÆ.

Cryptophagus, 7 unnamed species.
Paramecosoma serratum Gyllh.
n. sp. E.
Atomaria ephippiata Zimm. P.
13 unnamed species.

CUCUJIDÆ.

Pediacus fuscus E.
depressus Hbst. S. M.
Lathropus vernalis Lec. M.
Læmophlœus biguttatus Say M.
adustus Lec. M.
Dendrophagus glaber Lec. M.
Brontes dubius Fabr. M.

COLYDIIDÆ.

Ditoma quadriguttata Say. M.
Synchita nigripennis Lec. M.
Lasconotus borealis Horn M.
Philothermus glabriculus Lec. M.
Cerylon castaneum Say E. M. B.

RHIZOPHAGIDÆ.

Rhizophagus dimidiatus Mannh. B.
brunneus Horn, n. sp. M.

TROGOSITIDÆ.

Tenebroides collaris St. M.
Tenebroides castanea Melsh. M.
Peltis ferruginea Linn. M.
Grynocharis 4-lineata Melsh. M.
Calitys scabra Thunb. E. M.
Thymalus fulgidus Er. M. B. Mr.

NITIDULIDÆ.

Byturus n. sp. ? M.
Colastus truncatus Rand M.
Carpophilus brachypterus Say E.G.
discoideus Lec.
Epuræa helvola Er. M.
rufa Say. M.
Erichsonii Reitter.*
immunda Sturm. M.
truncatella Mann. M.
planulata Er. M.
æstiva Linn. M.
labilis Ev.
Nitidula ziczac Say. M.
Soronia grisea Linn. M.
Omosita discoidea Fab. I.
Stelidota sp. M.
Meligethes seminulum Lec.
Cyllodes biplagiatus Lec. M.
Thalycra concolor Lec.* Nt'h Sh.
Ips 4-guttatus Fabr. M.
sanguinolentus Oliv. M.
confluens Say.*

PHALACRIDÆ.

Phalacrus politus Melsh. M. I.
n. sp. ? M. B.
Olibrus striatulus Lec. B.
consimilis Melsh. M. Mr.
nitidus Melsh. S.

COCCINELLIDÆ.

Hippodamia 5-signata Kby. E.
glacialis Fabr.*
15-maculata Muls. B.
13-punctata Linn. M. Mr.
parenthesis Say. M. Mr.

Anisosticta strigata Thunb. M.
Coccinella affinis Rand. E. M.
trifasciata Linn. M. I.
9-notata Hbst. M.
transversalis Muls. B. I.
5-notata Kirby.*
Cycloneda sanguinea Linn. Mr. I.
Harmonia picta Rand E. M. I.
Anisocalvia 14-guttata Linn. M.
12-maculata Gebl. M.
Anatis 15-punctata Ol.
Mysia pullata Say. E. M.
Chilocorus bivulnerus Muls. M.
Exochomus marginipennis Lec. M.
Pentilia marginata Lec. n. sp. M.
Brachiacantha ursina Fabr. small var.*
Hyperaspis dissoluta Crotch.*
signata Oliv. M.
fimbriolata Mels.* Nt'h Sh.
disconotata Lec.* N'th Sh.
bigeminata Rand. M.
undulata Say. E. M.
mœrens Lec.* North Shore.
Scymnus ornatus Lec. M.
americanus Muls. S. M.
fraternus Lec. M.
consobrinus Lec. M.
lacustris Lec. E. M. I.
abbreviatus Lec. M.
nanus Lec. M.
punctum Lec. E. M.
n. sp. M.

BYRRHIDÆ.

Simplocaria metallica Sturm. N S.
Pedilophorus subcanus Lec. n.sp. E. M.
Cytilus trivittatus Melsh.
Byrrhus americanus Lec. E. M.
cyclophorus Kby. E. M.
geminatus Lec. I.
Pettitii Horn E. M.
eximius Lec. Nt'h Sh.
murinus Fabr. M.
Syncalypta echinata Lec. M.

PSEPHENIDÆ.

Psephenus Lecontei Lec. E.

PARNIDÆ.

Helichus striatus Lec. M.

ELMIDÆ.

Elmis 4-notatus Say. M.
fastiditus Lec* North Shore.

HETEROCERIDÆ.

Heterocerus substriatus Kw. M.
sp. M.

HISTERIDÆ.

Hister merdarius Hoffm. E. M.
interruptus Beauv. E.
immunis Er. E.
abbreviatus Fab. M.
curtatus Lec. S.
depurator Say.*
americanus Payk. E.
subrotundus Say.*
Lecontei Mars. M.
parallelus Say. M.
basalis Lec. M. I.
cylindricus Payk. M.
Paromalus teres Lec. n.sp. S.
bistriatus Er.*
Saprinus oregonensis Lec.*
pensylvanicus Payk.*
assimilis Payk.*
sphæroides Lec.
fraternus Say. M. G. Mr.
mancus Say. E. M. B.
Plegaderus Sayi Mars. S. M. I.

LUCANIDÆ.

Platycerus depressus Lec. M.
quercus Weber.
Ceruchus piceus Web. M.

SCARABÆIDÆ.

- **Aphodius pinguis** Hald. M.
  - **hyperboreus** Lec. E.
  - **ruricola** Melsh. M.
  - **granarius** Linn. M.
  - **vittatus** Say. M.
  - **consentaneus** Lec.* N'th Sh.
- **Dialytes striatulus** Say. M.
- **Atænius stercorator** Fab. M.
- **Ægialia lacustris** Lec. M. Mr.
  - **conferta** Horn. Duluth.
  - **rufa** Lec. n sp. M.
  - **spissipes** Lec. n.sp. M.
- **Odontæus cornigerus** Melsh Mr.
- **Geotrupes Egeriei** Germ. Mr.
- **Trox unistriatus** Beauv. M.
- **Hoplia trifasciata** Say.*
- **Dichelonycha elongata** Fab. E. M.
  - **subvittata** Lec. M.
  - **testacea** Kirby.*
  - **Backii** Kirby.* North Shore.
  - **albicollis** Burm. M.
- **Serica vespertina** Schh. M. Mr.
  - **tristis** Lec. B. M.
  - **sericea** Ill. G. M.
- **Diplotaxis sordida** Say. M.
  - **liberta** Germ. E. M.
- **Lachnosterna fusca** Frœhl.*
  - **futilis** Lec.
- **Cotalpa lanigera** Linn.* M.
- **Ligyrus relictus** Say. E.
- **Trichius affinis** Gory. E. M. S. I.

BUPRESTIDÆ.

- **Chalcophora virginiensis** Dr. M.
- **Dicerca prolongata** Lec. E. M.
  - **divaricata** Say. M.
  - **tenebrosa** Kby. M. Mr. I.
  - **manca** Lec. M.
  - **lugubris** Lec. M.
- **Buprestis lineata** Fabr. E. M.
  - **consularis** Gory. E. M.
  - **Nuttalli** Kirby.*
  - **maculiventris** Say.
- **Buprestis fasciata** Fabr. E. M. I.
  - **var. Langii** Mannh. I.
  - **sulcicollis** Lec. M.
  - **striata** Fabr. M.
- **Melanophila longipes** Say. S. M.
  - **fulvoguttata** Harr. E. M. I.
  - **æneola** Melsh. M.
- **Chrysobothris femorata** Lec. M.
  - **floricola** Gory. E. M.
  - **dentipes** Germ.
  - **trinervia** Kby. M. B. I
  - **scabripennis** Lap. M. B.
  - **Harrisii** Hentz. M.
- **Agrilus torquatus** Lec. M.
  - **bilineatus** Web. M.
  - **vittaticollis** Rand. E.
  - **torpidus** Lec. M.
  - **plumbeus** Lec.*
  - **politus** Say. M.
  - **egenus** Gory. M.
  - **lacustris** Lec.*

THROSCIDÆ.

- **Throscus alienus** Bonv. S. B.
  - **punctatus** Bonv. M.
  - **Chevrolati** Bonv. M.

ELATERIDÆ.

- **Tharops obliqua** Say. M.
- **Deltometopus amœnicornis** Say. M
- **Fornax calceatus** Say.* E. H.
- **Microrhagus triangularis** Say. M.
- **Hypocœlus terminalis** Lec. M.
- **Adelocera aurorata** Say. M.
  - **brevicornis** Lec. E. M.
- **Alaus oculatus** Linn. M.
  - **myops** Fab. M.
- **Cardiophorus amictus** Melsh. E.
  - **convexulus** Lec. E. M.
- **Cryptohypnus abbreviatus** Say. M.
  - **bicolor** Esch. M. S. I.
  - **tumescens** Lec. S. I.
  - **striatulus** Lec.*
  - **pectoralis** Say. M. Mr.

Cryptohypnus futilis Lec. Mr.
Elater semicinctus Rand. M.
linteus Say.*
vitiosus Lec. M.
apicatus Say. M.
luctuosus Lec.*
socer Lec. E. M.
molestus Lec.*
fuscatus Melsh. M.
pedalis Cand. E. M.
nigrinus Payk. var. ? E. M. I.
lacustris Lec. M.
fusculus Lec.*
deletus Lec.*
pullus Cand. E. M.
mixtus Hbst. M. Mi. I.
rubricus Say. E. M.
protervus Lec.*
Drasterius dorsalis Say. M.
Megapenthes stigmosus Lec. E. M.
Monocrepidius auritus Herbst.*
Agriotes mancus Say.*
pubescens Melsh. M.
fucosus Lec. M.
stabilis Lec. M.
limosus Lec. E.M.Mr.I.
oblongicollis Mels.* E. H.
Dolopius lateralis Esch.
Betarmon bigeminatus Rand. M. I.
Melanotus Leonardi Lec. M. I.
scrobicollis Lec. E. M. I.
castanipes Payk. M.
communis Gyllh. E.
Limonius aurifer Lec. M.
confusus Lec.* E. H.
æger Lec. M. I.
pectoralis Lec. M.
Campylus productus Rand M.
denticornis Kby. M. I.
Athous acanthus Say. E.
scapularis Say. M.
reflexus Lec. M. Mr.
Paranomus costalis Payk. I.G.
estriatus Lec. M.
Nothodes dubitans Lec. M.
Sericosomus fusiformis Lec. E. M
Sericosomus incongruus Lec. M. I.
Corymbites virens Schh. M.
resplendens Esch. M. Mi. I.
cylindriformis Herbst.*
caricinus Esch. M.
spinosus Lec. E. M. I.
mendax Lec. EH. I.
insidiosus Lec. M. I.
falsificus Lec. M. I.
appressus Lec.* EH.
fallax Say.* North Shore.
medianus Germ. E.M.I.
triundulatus Rand.M.I.
hamatus Say.
propola Lec. M.Mr.I.
nigricollis Bland. M.I.
hieroglyphicus Say. E. M.
æripennis Kby. M. I.
splendens Ziegl. M.
aratus Lec. E.M. I.
metallicus Payk. M. I.

DASCYLLIDÆ.

Macropogon piceus Lec. I.
Eurypogon niger Melsh. Mr. I.
Cyphon fuscicops Kby. M. Mr.
piceus Lec. E. M.
nebulosus Lec. S. M.
modestus Lec. S.
pusillus Lec. B. Mr.
Prionocyphon discoideus Say M.
Scirtes tibialis Guér. E.
Eucinetus oviformis Lec. M.
terminalis Lec. E. M. I.

LAMPYRIDÆ.

Dictyoptera perfaceta Say. M.
Calopterum typicum Newm. M.
reticulatum Fabr. E. M.
Cænia dimidiata Fabr.
basalis Newm. E. M.
Eros coccinatus Say. M.
crenatus Germ. M.
thoracicus Randall M.

Eros humeralis Fabr. M.
trilineatus Melsh. M.
modestus Say. M. I.
Lucidota atra Fabr. E.
Photinus corruscus Linn. I. Mr.
var. lacustris Lec. B.
decipiens Harr. M.
borealis Rand. M.
lucifer Melsh. M.
ardens Lec. M.
Phausis inaccensa Lec. n. sp. M.
Photuris pensylvanica DeG. E.

TELEPHORIDÆ.

Podabrus modestus Say. E.M.I.
diadema Fabr. E. M.
rugosulus Lec *
piniphilus Eschsch. M.
punctatus Lec. M.
puncticollis Kby.*
lævicollis Kby. M. Mr. I.
puberulus Lec.*
three undescribed species.
Telephorus carolinus Fabr, M.
rectus Melsh. M.
lineola Fabr.
flavipes Lec.
var. dichrous Lec.
fraxini Say. M.
n. sp.?
rotundicollis Fabr. M.
Curtisii Kby. M. Mr. I.
tuberculatus Lec. M.
Silis percomis Say. M.
difficilis Lec. M.
Malthodes concavus Lec. M. I.
transversus Lec. I.
fragilis Lec. I.
niger Lec. M. I.

MALACHIIDÆ.

Collops vittatus Say. E.
tricolor Say.*
Anthocomus Erichsoni Lec. M.
Attalus nigrellus Lec. M.

CLERIDÆ.

Clerus nigripes Say. M.
nigrifrons Say. M.
dubius Fab. M. E.
undatulus Say. E. M. I.
Hydnocera difficilis Lec. M.
pallipennis Say. E.
verticalis Say. M.
Corynetes violaceus Linn. M.

LYMEXYLIDÆ.

Hylecœtus lugubris Say. M.

PTINIDÆ.

Ernobius mollis Linn. M.
granulatus Lec. M.
Xestobium squalidum Lec. M.
Oligomerus sericans Melsh. E.
Hadrobregmus errans Melsh. M.
carinatus Say. E.
foveatus Kby. M.
Anobium notatum Say. E. M.
Petalium bistriatum Say. M.
Theca profunda Lec. M.
Xyletinus fucatus Lec. M.
Dorcatoma pallicorne Lec. M.
Cænocara oculata Say. M.
Ptilinus ruficornis Say. M.
Hendecatomus rugosus Rand. M.
Bostrichus armiger Lec. M.
Amphicerus bicaudatus Say. M.
Dinoderus substriatus Payk. E. M. B. I.
cribratus Lec. M.
densus Lec. M.

SPONDYLIDÆ.

Parandra brunnea Fab. E.
Spondylis upiformis Mann.* E. H.

CERAMBYCIDÆ.

Tragosoma Harrisii Lec. E. M.

Asemum mœstum Hald. M.
Criocephalus agrestis Kby.
Tetropium cinnamopterum KbyMI.
Phymatodes dimidiatus Kby. M.
maculicollis Lec. n. sp. I.
Merium Proteus Kby. M.
Gonocallus collaris Kby. M.
Elaphidium villosum Fab. M.
parallelum Newm. M.
Glycobius speciosus Say.*
Calloides nobilis Harris. E. M.
Arhopalus fulminans Fab. E.
Xylotrechus colonus Fab. M.
undulatus Say. M. B. I.
annosus Say. M.
Neoclytus muricatulus Kby. M.
Clytanthus ruricola Ol.
Cyrtophorus gibbulus Lec. I.
Atimia confusa Say. M.
Encyclops cæruleus Say. M.
Rhagium lineatum Oliv.
Centrodera decolorata Harris.
Pachyta monticola Rand M. I.
liturata Kirby.*
Anthophilax viridis Lec M.
malachiticus Hald. M.
attenuatus Hald. M.
Acmæops discoidea Hald. M.
Proteus Kby. M. I.
pratensis Laich. M.
Gaurotes cyanipennis Say. M.
Bellamira scalaris Say. E. M.
Typocerus sparsus Lec. n. sp. E.
Leptura plebeja Rand. E. M.
subhamata Rand. E.
capitata Newm. M.
subargentata Kby. M. I.
similis Kby. M.
cordifera Ol.*
sexmaculata Linn. M.
nigrella Say. M.
n. sp. ? M. (**nigrella** ♂?)
canadensis Fab. E. M.
rubrica Say. M.
vagans Ol. E. M.
sanguinea Lec. M.
Leptura chrysocoma Kby. S. M. I.
proxima Say. M.
rufula Hald. I.
tibialis Lec. M.
pedalis Lec. M.
vittata Germ. E. M.
pubera Say. M.
sphæricollis Say. M.
vibex Newm. M.
mutabilis Newm. M. I.
aspera Lec. S. M.
Monohammus maculosus Hald. M.
scutellatus Say.
confusor Kby.
marmoratus Rand. M.
Acanthoderes decipiens Hald. M.
Leptostylus commixtus Hald. M.
macula Say.*
Sternidius alpha Say. E.
Liopus quercus Fitch. M.
Lepturges symmetricus Hald. M.
Hyperplatys maculatus Hald. M.
Graphisurus fasciatus DeG. M.
pusillus Kby.*
Acanthocinus obsoletus Oliv. M.
Pogonocherus pennicollatus Lec.M
mixtus Hald. M. Mr. I.
parvulus Lec. M.
Saperda calcarata Say. M.
mœsta Lec. E.
concolor Lec. M.

CHRYSOMELIDÆ.

Donacia piscatrix Lac. M.
porosicollis Lac. M.
hirticollis Kby. E.
proxima Kby.*
magnifica Lec. M.
distincta Lec. E.
subtilis Kunze. E. M.
confusa Lec.*
emarginata Kby. M.
flavipes Kby.*
cuprea Kby. M.
jucunda Lec. M.

- **Macroplea Melsheimeri** Lac. E.
- **Orsodachna Childreni** Kby. I.
- **Zengophora varians** Cr. I.
    - **abnormis** Lec.*
- **Syneta ferruginea** Germ. M. I.
- **Lema trilineata** Oliv. M.
- **Cryptocephalus sellatus** Suffr. E. M. I.
    - **venustus** Fabr. E.
    - **4-maculatus** Say. E.
    - **catarius** Suffr. S. P. Mr.
    - **auratus** Fabr. S.
- **Pachybrachys carbonarius** Hald.? M.
    - **M-nigrum** Melsh? S.
    - **sp.** S. M. I.
    - **abdominalis** Say.*
    - **hepaticus** Melsh. M.
- **Adoxus vitis** Linn.
- **Xanthonia 10-notata** Say.*
- **Heteraspis pubescens** Melsh. M.
- **Paria 6-notata** Say. M.
- **Fidia longipes** Mels.*
- **Chrysomela 10-lineata** Say. E. M.
    - **multiguttis** Stal.*
    - **philadelphica** Linn.*
    - **elegans** Ol. M.
    - **Bigsbyana** Kby. S. P. G. B.
- **Prasocuris varipes** Cr. S.
- **Gonioctena pallida** Linn. M. B. I.
- **Phyllodecta vulgatissima** Linn. I.
- **Plagiodera lapponica** Linn. M. G.
    - **tremulæ** Fab. E. M.
    - **scripta** Fabr. M.
- **Phyllobrotica decorata** Say. E. M.
- **Diabrotica 12-punctata** Ol. M. B. Mr.
- **Galeruca**[1] **rufosanguinea** Say. M.
- **Gallerucella sagittariæ** Gyllh. M.
    - **decora** Say.
- **Trirhabda canadensis** Kby. E.
    - **flavolimbata** Mannh. Mr.
- **Hypolampsis pilosa** Ill. M.
- **Œdionychis vians** Ill. M.
- **Disonycha pallipes** Cr. M.
    - **alternata** Ill. M.
- **Disonycha punctigera** Lec. M. B.
- **Graptodera bimarginata** Say. M.
    - **ignita** Ill.*
    - **exapta** Say. M. Mr
- **Longitarsus** sp. M. Mr.
- **Phyllotreta vittata** Fab. M.
- **Systena frontalis** Fabr. B.
- **Crepidodera Helxines** Linn. S.
    - **Modeeri** Linn. M.
- **Chætocnema confinis** Cr. M.
    - **rudis** Lec. n. sp. M.
- **Psylliodes punctulata** Melsh M.
- **Odontota rubra** Web. M.
    - **rosea** Web. M.
- **Cassida nigripes** Oliv. M.
- **Coptocycla guttulata** Oliv. M.
    - **purpurata** Boh. M.

TENEBRIONIDÆ.

- **Phellopsis obcordata** Lec. S. M.
- **Iphthimus opacus** Lec. M.
- **Upis ceramboides** Linn.
- **Haplandrus concolor** Lec. E. M.
- **Bius estriatus** Lec. M.
- **Blapstinus interruptus** Say. E. S. M.
- **Tribolium madens** Charp. M.
- **Paratenetus punctatus** Sol. M.
    - **fuscus** Lec. M. S.
- **Platydema americanum** Lap. M.
- **Scaphidema aeneolum** Lec. M. Mr.
- **Hypophlœus parallelus** Melsh.
- **Bolitotherus bifurcus** Fabr. M.
- **Bolitophagus corticola** Say. E. M.
    - **depressus** Rand. M.

CISTELIDÆ.

- **Hymenorus pilosus** Melsh E.
    - **punctulatus** Lec.
    - **niger** Melsh. E. M. I.
- **Isomira 4-striata** Coup.
- **Mycetochares Haldemani** Lec. M.
    - **bicolor** Coup. M.
    - **binotata** Say. M.
    - **gracilis** Lec. n. sp. M.

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[1] I cannot adopt the changes proposed by Mr. Crotch in the names of this and the next genus.—LEC.

PYROCHROIDÆ.

Ischalia costata Lec. M. B.
Schizotus cervicalis Newm. M.
Dendroides canadensis Latr. E. M.
concolor Newm. M.

ANTHICIDÆ.

Nematoplus collaris Lec. M.
Corphyra lugubris Say.*
Notoxus anchora Hentz. E. M.
Anthicus formicarius Laf. E. M.
floralis Payk. M.
scabriceps Lec.
cervinus Laf. Mr.
spretus Lec. M.
coracinus Lec. M.
pallens Lec. E. M.
granularis Lec. M. Mr.
Xylophilus piceus Lec. E. M.
n. sp. M.

MELANDRYIDÆ.

Canifa pallipes Melsh.
pallipennis Lec. n. sp. M.
Tetratoma tesselata Melsh M. Mi.
Stenotrachelus arctatus Say.* EH.
Penthe obliquata Fab. M. S.
Synchroa punctata Newm. M.
Phryganophilus collaris Lec. M.
Emmesa connectens Newm. M. I.
Melandrya striata Say. M.
Prothalpia undata Lec. M.
Xylita lævigata Hellen. Mi.
decolorata Rand. M.
Scotochroa atra Lec. M.
basalis Lec. E. M. I.
Carebara longula Lec. E.
Spilotus 4-pustulosus Melsh. E. M.
Zilora hispida Lec. M.
Serropalpus striatus Hellen.
Enchodes sericea Hald. M.
Dircæa liturata Lec. E. M.
fusca Lec. n. sp.
Symphora flavicollis Hald. E. M.
Hallomenus obscurus Lec. n. sp. M.
punctulatus Lec. Mi.
debilis Lec. E. M.
Eustrophus confinis Lec. E. M.
bicolor Say. M.
tomentosus Say. M.
Orchesia gracilis Melsh. M.

MORDELLIDÆ.

Anaspis nigra Hald. M. T.
flavipennis Hald. M. Mi.
rufa Say.
Mordella borealis Lec. S. M.
scutellaris Fabr. S. M. Mr.
lineata Melsh. E. M.
serval Say. M.
Glipodes helva Lec. M.
Mordellistena scapularis Say. E. M.
tosta Lec. M.
pectoralis Lec.* North Shore.
nigricans Melsh. E. M.
morula Lec.*
guttulata Hellm. M.
pityptera Lec. M.
Pelecotoma flavipes Melsh. M.
Myodites stylopides Newm. P.

MELOIDÆ.

Macrobasis unicolor Kirby.* N. S.
Epicauta convolvuli Melsh. M.
fissilabris Lec.* North Shore.

CEPHALOIDÆ.

Cephaloon lepturides Newm. M.
ungulare Lec. M.

ŒDEMERIDÆ.

Calopus angustus Lec. Mi.
Ditylus coeruleus Rand. M.
Asclera ruficollis Say. M.
puncticollis Say. M.

MYCTERIDÆ.

Mycterus scaber Hald. M.

PYTHIDÆ.

Pytho americanus Kby. M.
Crymodes discicollis Lec. M. I.
Priognathus monilicornis Randall.*
Boros unicolor Say. M. I.
Salpingus virescens Lec.
sp. M.
Rhinosimus nitens Lec. M. I.

RHINOMACERIDÆ.

Rhinomacer pilosus Lec. M.
elongatus Lec. M.

RHYNCHITIDÆ.

Rhynchites cyanellus Lec. M.

ATTELABIDÆ.

Attelabus bipustulatus Fabr. M.
rhois Boh. M.

OTIORHYNCHIDÆ.

Hormorus undulatus Uhler P.
Geoderces melanothrix Kby. B. Mi.

CURCULIONIDÆ.

Sitones flavescens All. M.
Trichalophus alternatus Say. Mr. I.
Ithycerus noveboracensis Forst. E.
Lepyrus geminatus Say. E.
Listronotus latiusculus Boh. M.
Macrops sp. M.
Hypomolyx pinicola Coup. M. Mi.
Hylobius confusus Kby.
Pissodes strobi Peck.
affinis Rand.
Pissodes dubius Rand. M. I.
Procas picipes Steph. M. Mr.
Erycus puncticollis Lec. P. B.
Dorytomus laticollis Lec. M. Mr.
brevicollis Lec. M. I.
sp. M.
luridus Mannh. M.
Tanysphyrus Lemnæ Gyllh. M.
Bagous mammillatus Say. M.
Magdalis hispoides Lec. M. I.
perforata Horn E. M.
pallida Say. M.
gentilis Lec. M. I.
olyra Herbst.*
Acalyptus Carpini Herbst. M.
Ellesckus bipunctatus Gyllh. M
Anthonomus scutellatus Gyl. EM.
signatus Say. M.
rufipennis Lec. M.
corvulus Lec. M. I.
Cratægi Walsh. M. I.
two undescribed species.
? **Anthonomus** n. sp. M.
Orchestes canus Horn. n. sp. M. I.
pallicornis Say. E. M. I.
subhirtus Horn. n. sp. M.
Piazorhinus scutellaris Gyll. M.
Proctorus armatus Lec. M.
decipens Lec. M.
Tyloderma æreum Say. E.
Cnemogonus Epilobii Payk. M. I.
Cœliodes cruralis Lec. M.
nebulosus Lec. M.
Ceuthorhynchus decipiens Lec. M.
Pelenomus sulcicollis Fabr. M.
Balaninus uniformis Lec. M.

BRENTHIDÆ.

Eupsalis minuta Dr. M.

CALANDRIDÆ.

Sphenophorus ochreus Lec. E.
pertinax Ol. E.
costipennis Horn. E.

Sphenophorus sculptilis Uhler. E.
Dryopthorus corticalis Say. M. P.
Nov. genus? near Himatium. S.
Cossonus subareatus Boh. E. M.
Phlœophagus apionides Horn. M.
Rhyncolus brunneus Mannh. S. M. Mi.

SCOLYTIDÆ.

Monarthrum mali Fitch. M.
Pityophthorus materiarius Fitch. M.
  sparsus Lec. M.
  plagiatus Lec. M.
  pu'lus Zimm. M.
  consimilis Lec. n. sp. M.
  hirticeps Lec. n. sp. M.
  puberulus Lec. M.
  pusio Lec. n. sp. M.
  opaculus Lec. n. sp. M.
Xyloterus bivittatus Kby. M.
Xyleborus cælatus Zimm. M.
Dryocœtes septentrionis Mannh. S. M. Mr. Mi.
  affaber Mannh. M.
  granicollis Lec. M.
Tomicus calligraphus Germ. M.
  cacographus Lec. M.
Tomicus pini Say.
  hudsonicus Lec. M.
  interruptus Lec. M.
  balsameus Lec. M.
Scolytus unispinosus Lec. M.
Polygraphus rufipennis Lec.
Phlœosinus dentatus Say. M.
  punctatus Lec.*
Dendroctonus terebrans Oliv. M.
  similis Lec. M.
  rufipennis Kby. M. I.
  frontalis Fabr.*
Hylastes porculus Er. M.
  cavernosus Zimm. M.
Hylurgops pinifex Fitch.

ANTHRIBIDÆ.

Gonotropis gibbosa Lec. M.
Eurymycter fasciatus Lec. M.
Allandrus bifasciatus Lec. M.
Cratoparis lunatus Fabr. M.
Brachytarsus variegatus Say. M.

APIONIDÆ.

Apion sp. M. I.
  sp. M.

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3. *Contribution to a List of the* Coleoptera *of the Lower Peninsula of Michigan.*

By H. G. Hubbard and E. A. Schwarz.

Localities:

A. Ann Arbor.
M. Monroe.
H. Port Huron.

Where no locality is given, Detroit is to be understood.

CICINDELIDÆ.

Cicindela scutellaris *var.* **Lecontei** Hald.
  sex-guttata Fabr.
  purpurea Oliv.
Cicindela generosa Dej. H.
  tranquebarica Hbst.
  12-guttata Dej.
  repanda Dej.
  hirticollis Say.

CARABIDÆ.

- **Omophron robustum** Horn. M.
  - **americanum** Dej.
- **Elaphrus Clairvillei** Kby. H.
  - **riparius** Linn.
  - **ruscarius** Say.
- **Notiophilus æneus** Hbst.
  - **semistriatus** Say.
  - **sibiricus** Mots.
  - **Hardyi** Putz.
- **Nebria pallipes** Say.
- **Calosoma scrutator** Fab.
  - **frigidum** Kby.
  - **calidum** Fabr.
- **Carabus palustris** Fisch.
  - **vinctus** Web.
- **Cychrus Lecontei** Dej.
- **Scarites subterraneus** Fab.
- **Dyschirius Dejeanii** Putz.
  - **nigripes** Lec.
  - **æneolus** Lec.
  - **longulus** Lec.
  - **edentulus** Putz.
  - **setosus** Lec.
  - **brevispinus** Lec. n. sp. p.
- **Clivina impressifrons** Lec.
  - **americana** Dej.
  - **rufa** Lec.?
  - **bipustulata** Fab.
- **Schizogenius ferrugineus** Putz. M.
- **Brachinus janthinipennis** Dej.
  - **medius** Harr.
  - **conformis** Dej.
  - **fumans** Fabr
  - **stygicornis** Say.
- **Galerita Janus** Fab.
- **Casnonia pensylvanica** Linn.
- **Plochionus timidus** Hald. H.
- **Loxopeza grandis** Hentz.
  - **atriventris** Say.
  - **tricolor** Say.
- **Lebia pulchella** Dej.
  - **viridis** Say.
  - **var. mœsta** Lec.
  - **pumila** Dej.
- **Lebia viridipennis** Dej.
  - **ornata** Say.
  - **fuscata** Dej.
- **Dianchomena scapularis** Dej.
- **Tetragonoderus fasciatus** Hald.
- **Perigona nigriceps** Dej. A.
- **Dromius piceus** Dej.
- **Metabletus americanus** Dej.
- **Blechrus linearis** Lec. A.
- **Axinopalpus biplagiatus** Dej.
- **Apenes lucidula** Dej.
- **Cymindis cribricollis** Dej.
  - **pilosa** Say.
  - **americana** Dej. A.
  - **neglecta** Hald.
- **Pinacodera limbata** Dej.
  - **platicollis** Say.
- **Callida punctata** Lec.
- **Calathus gregarius** Say.
  - **impunctatus** Say.
- **Platynus hypolithus** Say.
  - **pusillus** Lec.
  - **tenebricosus** Gemm.
  - **decens** Say.
  - **sinuatus** Dej.
  - **extensicollis** Say.
  - **decorus** Say.
  - **molestus** Lec.
  - **melanarius** Dej.
  - **affinis** Kby.
  - **cupripennis** Say.
  - **crenistriatus** Lec.
  - **æruginosus** Dej.
  - **excavatus** Dej.
  - **ferreus** Hald.
  - **subcordatus** Lec.
  - **nutans** Say.
  - **sordens** Kby.
  - **ruficornis** Lec.
  - **picipennis** Kby.
  - **lutulentus** Lec.
  - **id.** *var.* black.
  - **8-punctatus** Fabr.
  - **placidus** Say.
  - **obsoletus** Say.
  - **octocolus** Mannh.

- **Olisthopus parmatus** Say.
  - **micans** Lec. A.
- **Pterostichus adoxus** Say.
  - **honestus** Say.
  - **coracinus** Newm.
  - **stygicus** Say.
  - **Sayi** Brullé.
  - **lucublandus** Say.
  - **caudicalis** Say.
  - **luctuosus** Dej.
  - **corvinus** Dej.
  - **mutus** Say.
  - **Luczotii** Dej.
  - **erythropus** Dej.
  - **patruelis** Dej.
  - **femoralis** Kby.
- **Lophoglossus scrutator** Lec.
- **Myas cyanescens** Dej. Grand Haven.
- **Amara avida** Say.
  - **arenaria** Lec. H.
  - **latior** Kby. A.
  - **angustata** Say.
  - **impuncticollis** Say.
  - **interstitialis** Dej.
  - **obesa** Say. H.
  - **gibba** Lec. H.
  - **musculus** Say. H.
- **Badister notatus** Hald.
  - **pulchellus** Lec.
  - **micans** Lec.
- **Diplochila laticollis** Lec.
  - *var.* **major** Lec.
- **Dicælus purpuratus** Bon.
  - **sculptilis** Say. A.
  - **teter** Bon. Lansing.
  - **politus** Dej.
- **Chlænius erythropus** Germ. Grand Haven.
  - **sericeus** Forst.
  - **cordicollis** Kirby.
  - **tricolor** Dej.
  - **pensylvanicus** Say.
  - **impunctifrons** Say. Grand Haven.
  - **niger** Rand.
- **Chlænius tomentosus** Say. Lansing (Cooke).
- **Anomoglossus emarginatus** Say. H.
  - **pusillus** Say. H.
- **Atranus pubescens** Dej. H.
- **Lachnocrepis parallelus** Say.
- **Oodes fluvialis** Lec.
- **Geopinus incrassatus** Dej.
- **Agonoderus lineola** Fab.
  - **comma** Fabr.
  - **pallipes** Fabr.
  - **partiarius** Say.
  - **pauperculus** Dej.
  - **testaceus** Dej.
  - **n. sp.?**
- **Anisodactylus rusticus** Dej.
  - **carbonarius** Say.
  - **nigerrimus** Dej.*
  - **Harrisii** Lec.
  - **nigrita** Dej.
  - **Lecontei** Chd.
  - **agricola** Harr.
  - **discoideus** Dej.
  - **baltimorensis** Say.
  - **sericeus** Harr.
- **Xestonotus lugubris** Dej.
- **Spongopus verticalis** Lec. H.
- **Amphasia instertitialis** Say.
- **Anisotarsus piceus** Lec.
  - **terminatus** Say.
- **Gynandropus hylacis** Say.
- **Bradycellus dichrous** Dej.
  - **autumnalis** Say.
  - **badiipennis** Hald.
  - **atrimedius** Say.
  - **axillaris** Mannh.
  - **rupestris** Say.
- **Harpalus caliginosus** Fabr.
  - **faunus** Say.
  - **vagans** Lec.
  - **pensylvanicus** DeG.
  - **compar** Lec.
  - **erythropus** Dej.
  - **spadiceus** Dej.
  - **pleuriticus** Kby.

Harpalus herbivagus Say.
laticeps Lec. Lake Huron
basilaris Kby. A. H.
Stenolophus fuliginosus Dej.
plebejus Dej.
conjunctus Say.
ochropezus Say.
hydropicus Lec.
carus Lec.
Trechus micans Lec.
Bembidium americanum Dej.
chalceum Dej.
striola Lec.
lucidum Lec.
patruele Dej.
variegatum Say.
versicolor Lec.
sulcatum Lec.
anguliferum Lec.
cautum Lec.
assimile Gyllh.
4-maculatum Linn.
pedicellatum Lec.
Tachys proximus Say.
lævis Say.
nanus Gyllh.
flavicauda Say.
vivax Lec.
xanthopus Lec.
incurvus Say.

HALIPLIDÆ.

Haliplus fasciatus Aub.
punctatus Aub.*
triopsis Say.
borealis Lec. M.
cribrarius Lec.
Cnemidotus edentulus Lec.

DYTISCIDÆ.

Hydrovatus cuspidatus Germ.
Hydroporus inæqualis Fabr.
convexus Aub.
turbidus Lec.
nubilus Lec.
Hydroporus granarius Aub.
lacustris Say.
fuscatus Cr.
flavicollis Lec.
rotundatus Lec.
griseostriatus DeG. A.
undulatus Say.
mixtus Lec.
modestus Aub.
dichrous Melsh.
Hydroporus americanus Aub.
tartaricus Lec.
tristis Payk.
oblitus Aub.
conoideus Lec. H.
laccophilinus Lec. n. sp.
Suphis semipunctatus Lec. n. sp.
Laccophilus maculosus Germ.
fasciatus Aub.
Acilius semisulcatus Aub.
Thermonectes basilaris Harr. A.
Graphoderes cinereus Linn. H.
Hydaticus stagnalis Fab. H.
piceus Lec.
Colymbetes sculptilis Harr.
Dytiscus Harrisii Kby.
fasciventris Say.
Rhantus binotatus Harr.
tostus Lec.
Ilybius picipes Kby.
biguttulus Germ.
fraterculus Lec.
ignarus Lec. H.
Matus bicarinatus Say.
Coptotomus interrogatus Fab.
Copelatus glyphicus Say.
Ilybiosoma bifarium Kby. H.
Gaurodytes disintegratus Cr. A.
semipunctatus Kby.
ovoideus Lec. H.
punctulatus Aub.
gagates Aub.

GYRINIDÆ.

Dineutes emarginatus Say.
discolor Aub.*

- **Dineutes assimilis** Aub.
- **Gyrinus fraternus** Coup.
  - **æneolus** Lec.
  - **limbatus** Say.
  - **ventralis** Kby.
  - **maculiventris** Lec.
  - **picipes** Aub.
  - **analis** Say.
  - **minutus** Fab. H.

HYDROPHILIDÆ.

- **Helophorus lineatus** Say.
  - **tuberculatus** Gyllh.
  - **sp.** near **lacustris.**
  - two new species.
- **Hydrochus squamifer** Lec.
  - two new sp.
- **Hydræna pensylvanica** Kw.
- **Hydrophilus ovatus** Har.
  - **triangularis** Say.
- **Tropisternus nimbatus** Say.
  - **glaber** Hbst.
  - **mixtus** Lec.
- **Hydrocharis obtusatus** Say.
- **Berosus striatus** Say.
- **Chætarthria pallida** Lec.
- **Philhydrus nebulosus** Say.
  - **bifidus** Lec.
  - **ochraceus** Mels.
  - **consors** Lec.
  - **cinctus** Say.
  - **perplexus** Lec.
  - **fimbriatus** Melsh.
- **Hydrobius fuscipes** Linn.
  - **digestus** Lec.
  - **subcupreus** Say.
  - **despectus** Lec.
  - **feminalis** Lec. n. sp.
- **Cyclonotum estriatum** Say.
- **Cercyon flavipes** Er.
  - **naviculare** Zimm.
  - **centromaculatum** St.
  - **prætextatum** Say.
  - **ocellatum** Say.
  - **unipunctatum** Linn.
- **Cercyon anale** Er.
  - two unnamed species.
- **Cryptopleurum vagans** Lec.

TRICHOPTERYGIDÆ.

- **Nossidium americanum** Mots.
  - **n. sp.**
- **Ptenidium evanescens** Marsham.
  - **lineatum** Lec.?
  - **sp.**
- **Ptilium Collani** Mkl.
- **Smicrus filicornis** Fairm.
- **Trichopteryx aspera** Hald.
  - **parallela** Mots.
  - **Dohrnii** Matth.
  - **Haldemani** Lec.
  - several unnamed species.
- **Pteryx balteata** Lec.
  - **n. sp.**
- **Ptinella quercus** Lec.
  - **n. sp.**

STAPHYLINIDÆ.

- **Falagria cingulata** Lec.
  - **bilobata** Say.
  - **dissecta** Er.
  - **venustula** Er.
- **Hoplandria lateralis** Melsh.
- **Homalota trimaculata** Er.
  - **analis** Grav.
  - **lividipennis** Mannh.
  - numerous unnamed species.
- **Placusa** sp.
- **Calodera** several species.
- **Bolitochara** sp.
- **Myrmedonia** sp. A.
- **Atemeles cavus** Lec. A.
- **Aleochara lata** Grav.
  - **brachyptera** Fourc.
  - **nitida** Grav.
  - several unnamed species.
- **Oxypoda** several species.
- **Phlœopora** sp.
- **Oligota pedalis** Lec.
  - two unnamed species.

Gyrophæna vinula Er.
dissimilis Er.
flavicornis Melsh.*
corruscula Er.
socia Er.
several unnamed species.
Myllæna fuscipennis Kr.
dubia Er.
one unnamed species.
Dinopsis americanus Kr.
myllænoides Kr.
(Numerous undetermined genera of **Aleocharini**).
Tachinus memnonius Grav.
repandus Horn.
luridus Er.
canadensis Horn.
fimbriatus Grav.
Schwarzii Horn. Paw Paw.
frigidus Er.
circumcinctus Mkl.
nitiduloides Horn.
Tachyporus maculipennis Lec.
elegans Horn.
jocosus Say.
chrysomelinus Linn.
nanus Er.
brunneus Fab.
Cilea silphoides Linn.
Erchomus ventriculus Say.
Conosoma littoreum Linn.
Knoxii Lec.
crassum Grav.
pubescens Payk.
basale Er.
opicum Say.
scriptum Horn.
Bolitobius niger Grav.
dimidiatus Er. var.?
cingulatus Mannh.
cincticollis Say.
anticus Horn.
pygmæus Fab.
trinotatus Er.
obsoletus Say.*
cinctus Grav.
Bryoporus rufescens Lec.
var. **testaceus** Lec.
Mycetoporus lepidus Er.
lucidulus Lec.
consors Lec.
americanus Er.
pictus Horn.
Habrocerus Schwarzii Horn.
Acylophorus flavicollis Sachse.
pronus Er.
Heterothops fumigatus Lec.
pusio Lec.
Quedius fulgidus Fab.
lævigatus Gyllh.
vernix Lec.
capucinus Grav.
molochinus Grav.
five unnamed species.
Creophilus villosus Grav.
Leistotrophus cingulatus Grav.
Staphylinus maculosus Grav.
vulpinus Nordm.
fossator Grav.
tomentosus Grav.
cinnamopterus Grav.
violaceus Grav.
varipes Sachse.
cæsareus Cederh.
Ocypus ater Grav.
Belonuchus formosus Grav.
Philonthus cyanipennis Fabr.
æneus Rossi.
umbratilis Grav.
hepaticus Er.
blandus Grav.
lætulus Say.
niger Melsh.
scybalarius Nordm.
debilis Grav.
lomatus Er.
fulvipes Fabr.
brunneus Grav.
aterrimus Grav.
baltimorensis Grav. Kalamazoo.
apicalis Say.

Philonthus sobrinus Er.
pæderoides Lec.
cinerascens Grav.
several unnamed species.
Xantholinus cephalus Say.
emmesus Grav.
obsidianus Melsh.
obscurus Er.
Leptacinus two n. sp.
Leptolinus longicollis Lec.
sp.
Baptolinus pilicornis Payk.
Plymouth.
Diochus Schaumii Kr.
Lathrobium grande Lec.
punctulatum Lec.
angulare Lec.
puncticolle Kby.
simile Lec.
armatum Say.
nigrum Lec.
tenue Lec.
longiusculum Grav.
collare Er.
several unnamed species.
Cryptobium badium Grav.
bicolor Grav.
pallipes Grav.
latebricola Nordm.
flavicorne Lec.
cribratum Lec.
Stilicus rudis Lec.
angularis Er.
dentatus Say.
Scopæus exiguus Er.
four or five unnamed species.
Lithocharis corticina Grav.
confluens Say.
ochracea Grav.
one unnamed species.
Sunius prolixus Er.
linearis Er.
binotatus Say.
longiusculus Mannh.
brevipennis Aust.
Pæderus littorarius Grav.
Pæderus palustris Aust.
Palaminus testaceus Er.
normalis Lec.
Stenus Juno Fab.
erythropus Melsh.
femoratus Say.
egenus Er.
flavicornis Er.
annularis Er.
punctatus Er.
numerous undescribed species.
Euæsthetus americanus Er.
Edaphus nitidus Lec.
Oxyporus femoralis Grav.
vittatus Grav.
lateralis Grav.
Bledius semiferrugineus Lec.
fumatus Lec.
analis Lec.
assimilis † Fauvel.
annularis Lec.
emarginatus Say.
Oxytelus sculptus Grav.
rugosus Er.
insignitus Grav.
pensylvanicus Er.
nitidulus Grav.
exiguus Er.
Thinobius brachypterus Lec.
fimbriatus Lec.
Trogophlœus laticollis Lec.
arcifer Lec.
4-punctatus Say.
numerous undescribed species.
Apocellus sphæricollis Say.
Anthophagus verticalis Say.
Acidota subcarinata Er.
seriata Lec.
Olophrum rotundicolle Say.
two unnamed species.
Coryphium notatum Lec.
Omalium several unnamed species.
Phlœonomus convexus † Zimm.
Protinus parvulus Lec.

- **Megarthrus excisus** Lec.
- **Siagonium americanum** Melsh.
- **Eleusis pallidus** Lec.
  - **picipennis** Lec.
- **Glyptoma costale** Er.
- **Pseudopsis sulcata** Newm.
- **Micropeplus tesserula** Curtis.

PSELAPHIDÆ.

- **Ceophyllus monilis** Lec. Plymouth.
- **Cedius spinosus** Lec.
- **Tmesiphorus carinatus** Say.
- **Ctenistes piceus** Lec.
  - **Zimmermanni** Lec.
  - **consobrinus** Lec.
- **Tyrus humeralis** Aub.
- **Pselaphus Erichsoni** Lec.
- **Tychus minor** Lec.
- **Bythinus zonatus** Br.
- **Bryaxis conjuncta** Lec.
  - **Brendelii** Horn.
  - **dentata** Say.
  - **puncticollis** Lec.
  - **scabra** Brend.
  - **rubicunda** Aub.
  - two doubtful species.
- **Decarthron abnorme** Lec.
  - **longulum** Br.
  - **formiceti** Lec.
- **Batrisus simplex** Lec. n. sp.
  - **Schaumii** Aubé.
  - **globosus** Lec.
  - **spretus** Lec.
  - **lineaticollis** Aub.
- **Rhexius insculptus** Lec.
- **Trimium dubium** Lec.
  - **americanum** Lec.
- **Euplectus interruptus** Lec.
  - **arcuatus** Lec.
  - **canaliculatus** Lec.
  - **integer** Lec. n. sp.
  - **crinitus** Brendel.

SILPHIDÆ.

- **Necrophorus marginatus** Fabr.
- **Necrophorus Sayi** Lap.
  - **pustulatus** Hersch.
  - **americanus** Oliv.
  - **orbicollis** Say.
  - **tomentosus** Web.
  - **vespilloides** Hbst.
- **Silpha surinamensis** Fab.
  - **lapponica** Hbst.
  - **noveboracensis** Forst.
  - **inæqualis** Fabr.
  - **americana** Linn.
- **Choleva opaca** Say.
- **Ptomaphagus brunneipennis** Mannh.
  - **consobrinus** Lec.
  - **oblitus** Lec.
- **Catopomorphus brachyderus** Lec.
- **Colon dentatum** Lec.
  - three unnamed species.
- **Hydnobius substriatus** Lec.
- **Anisotoma alternata** Melsh.
  - **punctostriata** Kby.
  - **collaris** Lec.
  - **obsoleta** Lec.
- **Cyrtusa egena** Lec.
  - **picipennis** Lec.
  - **sp.**
- **Colenis impunctata** Lec.
- **Aglyptus lævis** Lec.
- **Liodes discolor** Melsh.
  - **dichroa** Lec.
- **Agathidium oniscoides** Beauv.
  - **globatile** Lec. n. sp.
  - **exiguum** Melsh.
  - **politum** Lec.
- **Clambus puberulus** Lec.
  - **gibbulus** Lec.

SCYDMÆNIDÆ.

- **Eumicrus Zimmermanni** Sch. A.
- **Scydmænus perforatus** Schaum.
  - **magister** Lec.
  - **flavitarsis** Lec.
  - **fossiger** Lec.
  - **capillosulus** Lec.
  - **rasus** Lec.

Scydmænus clavipes Say.
consobrinus Lec.
bicolor Lec.
salinator Lec.
fatuus Lec.
several unnamed species.

CORYLOPHIDÆ.

Orthoperus glaber Lec.
scutellaris Lec. n. sp.
Corylophus marginicollis Lec.
truncatus Lec.
Sericoderus flavidus Lec.
obscurus Lec.
Sacium fasciatum Say.
lunatum Lec.
misellum Lec.

SCAPHIDIIDÆ.

Scaphidium 4-guttatum Say.
var. **4-pustulatum** Say.
var. **piceum** Melsh.
var. **obliteratum** Lec.
Bæocera concolor Fab.*
apicalis Lec.
Scaphisoma convexum Say.
suturale Lec.
terminatum Melsh.
pusillum Lec.
n. sp.
Toxidium gammaroides Lec.
compressum Zimm.

LATHRIDIIDÆ.

Stephostethus (n. g.) **liratus** Lec.
Lathridius carinatus Gyllh.
minutus Linn.
maculatus Lec. n. sp.
opaculus Lec. n. sp.
laticollis Lec. n. sp.
duplicatus Lec. n. sp.
filiformis Aub.
Corticaria serricollis Lec.
Corticaria deleta Mannh.
rugulosa Lec.
serrata Payk.
elongata Gyllh.
americana Mannh.
angularis Lec.
cavicollis Lec.
pumila Melsh.
picta Lec.
three unnamed species.

DERMESTIDÆ.

Dermestes nubilus Say.
mucoreus Lec.*
lardarius Linn.
talpinus Mann. (introduced).
Attagenus pellio Linn.
megatoma Fabr.
longulus Lec.
Trogoderma tarsale Melsh.
Cryptorhopalum ruficorne Lec.
hæmorhoidale Lec.
Anthrenus thoracicus Melsh.
varius Fabr.
museorum Linn.
Orphilus ater Er.

ENDOMYCHIDÆ.

Lycoperdina ferruginea Lec.
Mycetina perpulchra Newm.
testacea Lec.
vittata Fabr.
Endomychus biguttatus Fab.
Rhanis unicolor Ziegl.
Phymaphora pulchella Newm. A.
Mycetæa hirta Melsh.
Rhymbus minor Cr.

MYCETOPHAGIDÆ.

Mycetophagus punctatus Say.
flexuosus Say.
obsoletus Melsh.
bipustulatus Melsh.

- **Mycetophagus pluripunctatus** Lec.
- **Triphyllus humeralis** Kby.
- **Litargus tetraspilotus** Lec.
  - **6-punctatus** Say.
  - **infulatus** Lec.
  - **didesmus** Say.
- **Typhæa fumata** Linn.
- **Diplocœlus brunneus** Lec.

SPHINDIDÆ.

- **Odontosphindus denticollis** Lec. n. g. and sp.
- **Sphindus americanus** Lec.
- **Eurysphindus hirtus** Lec. n. g. and sp.

CIOIDÆ.

- **Cis creberrimus** Mell.
  - **brevisetosus** Cr.
  - **fuscipes** Mell.
  - three other species.
- **Ennearthron Mellyi** Mell.?
  - several other species.

EROTYLIDÆ.

- **Languria Mozardi** Latr.
  - **gracilis** Newm.
- **Dacne 4-maculata** Say.
- **Hypodacne punctata** Lec. A.
- **Megalodacne fasciata** Fab.
  - **heros** Say.
- **Ischyrus 4-punctatus** Oliv.
- **Mycotretus sanguinipennis** Say.
  - **pulchra** Say.
- **Cyrtotriplax humeralis** Fab.
  - **angulata** Say.
  - **unicolor** Say.
- **Triplax festiva** Lec.
  - **macra** Lec.
  - **thoracica** Say.
  - **flavicollis** Lac.

CRYPTOPHAGIDÆ.

- **Antherophagus ochraceus** Melsh.
- **Cryptophagus cellaris** Scop.
  - **croceus** Zimm.
  - **crinitus** Zimm.
  - **nodangulus** Zimm.
  - several unnamed species.
- **Paramecosoma serratum** Gyllh.
  - **n. sp.**
- **Tomarus pulchellus** Lec.
- **Atomaria ephippiata** Zimm.
  - numerous unnamed species.
- **Ephistemus apicalis** Lec.
- **Telmatophilus americanus** Lec.
- **Loberus impressus** Lec.
- **Silvanus advena** Waltl.
  - **surinamensis** Linn.
  - **bidentatus** Fab.
  - **planatus** Germ.
  - var. **cognatus** Lec.
  - **rectus** Lec.
- **Nausibius dentatus** Melsh,
- **Telephanus velox** Hald.

CUCUJIDÆ.

- **Catogenus rufus** Fab.
- **Cucujus clavipes** Fab.
- **Pediacus depressus** Hbst. H.
- **Lathropus vernalis** Lec.
- **Læmophlœus biguttatus** Say.
  - **fasciatus** Melsh.
  - **testaceus** Fab.
  - **adustus** Lec.
  - **convexulus** Lec. n. sp. H.
- **Narthecius grandiceps** Lec.
- **Brontes dubius** Fab.

LYCTIDÆ.

- **Lyctus planicollis** Lec. H.
  - **opaculus** Lec.

COLYDIIDÆ.

- **Coxelus guttulatus** Lec.
- **Ditoma 4-guttata** Say.
- **Synchita nigripennis** Lec.
  - **parvula** Guér. A.
- **Aulonium parallelopipedum** Say.

Colydium lineola Say.
Bothrideres geminatus Say.
Philothermus glabriculus Lec.
Cerylon castanum Say.
var. **unicolor** Ziegl.

RHYSSODIDÆ.

Rhyssodes exaratus Ill.

RHIZOPHAGIDÆ.

Rhizophagus bipunctatus Say.

MONOTOMIDÆ.

Bactridium ephippigerum Germ.
nanum Er.
striolatum Reitter.
Monotoma fulvipes Melsh.
picipes Hbst.
americana Aub.
parallela Lec.

TROGOSITIDÆ.

Nemosoma parallelum Mels.
Tenebrioides corticalis Melsh.
castanea Melsh.
nana Melsh.
bimaculata Melsh.
Calitys scabra Thunb.
Thymalus fulgidus Er.

NITIDULIDÆ.

Byturus unicolor Say.
Cercus abdominalis Er.
Brachypterus urticæ Fabr.
Colastus semitectus Say.
unicolor Say.
truncatus Rand.
Carpophilus niger Say.
brachypterus Say.
discoideus Lec.
Epuræa helvola Er.
Epuræa rufa Say.
Erichsonii Reitter.
immunda Sturm.
avara Rand.
truncatella Mann.
ovata Horn. n. sp.
peltoides Horn. n. sp.
labilis Er.
Nitidula bipustulata Linn.
ziczac Say.
var. **humeralis** Lec.
Prometopia 6-maculata Say.
Lobiopa undulata Say.
Omosita colon Linn.
Phenolia grossa Fab.
Stelidota 8-maculata Say.
Thalycra concolor Lec.
Cyllodes biplagiatus Lec.
Cychramus adustus Er.
Amphicrossus ciliatus Ol.
Pallodes silaceus Er.
Cybocephalus nigritulus Lec.
Cryptarcha ampla Er.
strigata Fabr.
liturata Lec.
Ips 4-guttatus Fab.
obtusus Say.
sanguinolentus Oliv.
confluens Say.

PHALACRIDÆ.

Phalacrus politus Melsh.
n. sp.
Olibrus ergoti † Walsh.
consimilis Melsh.
nitidus Mels.
Litochrus immaculatus Zimm.

COCCINELLIDÆ.

Megilla maculata DeG.
Hippodamia 13-punctata Linn.
parenthesis Say.
Anisosticta strigata Thunb.
Cocinella affinis Rand. H.

Cocinella trifasciata Linn.
  9-notata Hbst.
  monticola Muls.
Cycloneda sanguinea Linn.
Adalia bipunctata Linn.
Anatis 15-punctata Oliv.
Psyllobora 20-maculata Say.
Chilocorus bivulnerus Muls.
Œneis pusilla Lec.
Brachyacantha ursina Fab.
  indubitabilis Cr.
Hyperaspis signata Oliv.
  proba Say.
  bigeminata Rand.
  undulata Say.
Scymnus punctatus Melsh.
  terminatus Say.
  americanus Muls.
  fraternus Lec
  ochroderus Muls.
  cervicalis Muls.
  nanus Lec.
  punctum Lec.
  n. sp.
Pentilia misella Lec.
Coccidula lepida Lec.

BYRRHIDÆ.

Nosodendron unicolor Say.
Cytilus sericeus Forst.
  trivittatus Melsh. H.
Byrrhus americanus Lec.
  cyclophorus Kby.
  Pettiti Horn.
Limnichus punctatus Lec.
  obscurus Lec.

PSEPHENIDÆ.

Psephenus Lecontei Lec.

ELMIDÆ.

Elmis bicarinatus Lec.
Ancyronyx variegatus Germ.

HISTERIDÆ.

Hololepta fossularis Say.
Hister merdarius Hoffm.
  interruptus Beauv.
  immunis Er.
  cognatus Lec.
  fœdatus Lec.
  abbreviatus Fab.
  civilis Lec.*
  depurator Say.
  furtivus Lec.
  curtatus Lec.
  bimaculatus Linn.
  16-striatus Say.
  americanus Payk.
  perplexus Lec.
  subrotundus Say.
  carolinus Payk.
  Lecontei Mars.
  coarctatus Lec.
Epierus ellipticus Lec.
Tribalus americanus Lec.
Onthophilus alternatus Say.
Paromalus æqualis Say.
  bistriatus Er.
  seminulum Er. A.
Saprinus rotundatus Kug.
  distinguendus Mars.
  assimilis Payk.
  conformis Lec. A.
  sphæroides Lec. H.
  fraternus Say. H.
  mancus Say H.
  patruelis Lec.
Teretrius americanus Lec.
Plegaderus transversus Say. H.
Bacanius punctiformis Lec.
Acritus exiguus Er.
  strigosus Lec.
Æletes politus Lec.
  simplex Lec.

LUCANIDÆ.

Lucanus dama Thunb.

Lucanus placidus Say.
Dorcus parallelus Say.
Platycerus quercus Web.
depressus Lec.
Ceruchus piceus Web.
Passalus cornutus Fab.

SCARABÆIDÆ.

Canthon vigilans Lec.
Chœridium histeroides Web.
Copris anaglypticus Say.
minutus Dr.
Onthophilus Hecate Panz.
Janus var. **striatus** Beauv.
pensylvanicus Har.
Aphodius fossor Linn.
pinguis Hald. H.
fimetarius Linn.
ruricola Mels.
n. sp.?
granarius Linn.
vittatus Say.
inquinatus Hbst.
lentus Horn.
stercorosus Melsh.*
bicolor Say.
oblongus Say.
humeralis Lec.
Dialytes striatulus Say.
Atænius imbricatus Melsh.
gracilis Melsh.
stercorator Fab.
abditus Hald.
Ægialia lacustris Lec.
conferta Horn. M.
Bolboceras farctus Fab.
Odontæus filicornis Say.
cornigerus Melsh.
Geotrupes splendidus Fabr.
semiopacus Jek.
Egeriei Germ.
Blackburnii Fabr.
Balyi Jek.
Nicagus obscurus Lec. H.
Clœotus aphodioides Ill.
Trox unistriatus Beauv.
sordidus Lec. *
æqualis Say.
scaber Linn.
Hoplia trifasciata Say.
Dichelonycha elongata Fabr.
fuscula Lec.
albicollis Burm. H.
Serica vespertina Schh.
tristis Lec. ?
sericea Ill.
Macrodactylus subspinosus Fabr.
Diplotaxis sordida Say.
frondicola Say. A.
Endrosa quercus Kn.
Lachnosterna futilis Lec.
fusca Fröhl.
fraterna Harr.
ciliata Lec.
hirticula Kn.
hirsuta Kn.
crenulata Fröhl.
tristis Fabr.
Strigoderma arboricola Fabr.
Pelidnota punctata Linn.
Cotalpa lanigera Linn.
Ligyrus relictus Say.
Xyloryctes satyrus Fabr.
Euryomia inda Linn.
fulgida Fabr.
Osmoderma scabra Beauv.
Gnorimus maculosus Kn. H.
Trichius piger Fabr.
affinis Gory.
viridulus Fabr.

BUPRESTIDÆ.

Chalcophora virginiensis Dr. H.
campestris Say.
Dicerca divaricata Say.
obscura Fabr.
asperata Lap.
Pœcilonota cyanipes Say.
Buprestis consularis Gory H.
maculiventris Say. H.

Buprestis fasciata Fabr. H.
striata Fabr.
Melanophila longipes Say H.
fulvoguttata Harr. H.
Anthaxia cyanella Gory.
viridicornis Say.
viridifrons Gory.
quercata Fabr.
Chrysobothris femorata Lec.
dentipes Germ. H.
6-signata Say H.
scitula Gory.
Actenodes acornis Say.
Acmæodera pulchella Hbst.
culta Web.
Agrilus ruficollis Fab.
torquatus Lec.
defectus Lec.
difficilis Gor. H.
bilineatus Web.
acutipennis Mannh. H.
plumbeus Lec.
politus Say.
egenus Gory. H.
putillus Say.
Taphrocerus gracilis Say.
Brachys ovata Web.
ærosa Melsh.
Pachyscelus purpureus Say.
lævigatus Say.

THROSCIDÆ.

Throscus alienus Bono.
punctatus Bono.
Chevrolati Bono.
constrictor Say.
Drapetes geminatus Say.

ELATERIDÆ.

Tharops obliqua Say.
Deltametopus amœnicornis Say.
Dromæolus cylindricollis Say. *
Fornax bicolor Melsh. A.
calceatus Say.
Microrhagus humeralis Say.
triangularis Say.
Nematodes penetrans Lec.
Adelocera impressicollis Say.
discoidea Web.
aurorata Say.
obtecta Say.
Alaus oculatus Linn.
myops Fabr.
Cardiophorus amictus Melsh.
fenestratus Lec.? H.
convexulus Lec. H.
Cryptohypnus abbreviatus Say.
choris Say.
pectoralis Say. A.
obliquatulus Melsh.
Elater nigricollis Hbst.
linteus Say.
discoideus Fab.
semicinctus Rand.
vitiosus Lec. A.
apicatus Say.
socer Lec.
fuscatus Melsh.
pedalis Cand.
nigrinus Payk.
sanguinipennis Say.
rubricus Say.
obliquus Say.
Drasterius dorsalis Say.
Monocrepidius auritus Say.
Ludius abruptus Say.
attenuatus Say.
Agriotes mancus Say.
pubescens Melsh.
fucosus Lec. Lake Huron.
stabilis Lec.
oblongicollis Melsh.
Dolopius lateralis Eschsch.
Glyphonyx recticollis Say. ? A.
testaceus Melsh. ?
Melanotus depressus Melsh.
Leonardi Lec.
scrobicollis Lec. H.
castanipes Payk.
fissilis Say.

Melanotus communis Gyllh.
parumpunctatus Melsh.
americanus Hbst. ?
Limonius auripilis Say.
aurifer Lec.
griseus Beauv.
plebejus Lec.
basillaris Lec.
agonus Say.
Campylus denticornis Kby. H.
Pityobius anguinus Lec. Lansing
Athous Brightwelli Kby.
maculicollis Lec.
cucullatus Say.
fossularis Lec.
scapularis Say.
reflexus Lec. A. H.
Sericosomus viridanus Say. A.
Oxygonus obesus Say. A.
Corymbites virens Sch. H.
vernalis Hentz. Lansing.
tesselatus Linn.
cylindriformis Hbst.
pyrrhos Hbst.
sulcicollis Say.
hieroglyphicus Say.
metallicus Germ.
Asaphes baridius Say.
memnonius Hbst.
bilobatus Say.

DASCILLIDÆ.

Dicranopselaphus thoracicus Zeigl.
Cyphon pallipes Lec.
fusciceps Kby. H.
piceus Lec.
nebulosus Lec.
modestus Lec.
pusillus Lec.
ruficollis Say.
Prionocyphon discoideus Say.
Helodes pulchella Guér.
thoracica Guér.
explanata Lec.
Scirtes tibialis Guér.
Eucinetus terminalis Lec.
morio Lec.
strigosus Lec.
testaceus Lec.
punctulatus Lec.
Ptilodactyla serricollis Say.

LAMPYRIDÆ.

Calopteron typicum Newm.
var. **apicale** Lec.
Eros coccinatus Say.
thoracicus Rand.
sculptilis Say.
humeralis Fab. H.
modestus Say.
Lucidota atra Fabr.
Photinus corruscus Linn.
nigricans Say.
angulatus Say.
borealis Rand.
lucifer Mels.
angustatus Lec. H.
ardens Lec.
consanguineus Lec.
n. sp.
Photuris pensylvanica De G.
Phausis inaccensa Lec. n. sp. M.

TELEPHORIDÆ.

Chauliognathus marginatus Fab.
Podabrus tricostatus Say.
flavicollis Lec.
modestus Say.
diadema Fabr.
rugosulus Lec.
Telephorus excavatus Lec.
carolinus Fab.
angulatus Say.
lineola Fab.
rectus Melsh.
cruralis Lec.
dichrous Lec.?
luteicollis Germ.
scitulus Say.
vilis Lec.

- **Telephorus fraxini** Say.
  - **rotundicollis** Say.
  - **tuberculatus** Lec.
  - **bilineatus** Say.
  - **limbatus** Lec.
- **Silis percomis** Say.
- **Malthodes concavus** Lec.
  - **transversus** Lec.
  - **exilis** Melsh.
  - **fragilis** Lec.
  - **parvulus** Lec.

MALACHIIDÆ.

- **Collops 4-maculatus** Fabr.
  - **vittatus** Say. H.
- **Anthocomus Erichsonii** Lec.
- **Pseudebæus bicolor** Lec.
  - **oblitus** Lec.
- **Attalus terminalis** Er.
  - **pallifrons** Mots.
  - **Pettiti** Horn.
  - **morulus** Lec.

CLERIDÆ.

- **Cymatodera inornata** Say.
- **Priocera castanea** Newm.
- **Trichodes Nuttalli** Kby.
- **Clerus nigripes** Say.
  - **nigrifrons** Say.
  - **thoracicus** Oliv.
  - **dubius** Fab.
  - **sanguineus** Say.
- **Hydnocera humeralis** Say.
  - var. **difficilis** Lec.
  - var. **cyanescens** Lec.
  - **pallipennis** Say.
  - **verticalis** Say.
  - **tabida** Lec.
  - **longicollis** Ziegl.
- **Phyllobænus dislocatus** Say.
- **Orthopleura damicornis** Fabr.
- **Laricobius rubidus** Lec.
- **Corynetes violaceus** Linn.

LYMEXYLIDÆ.

- **Hylecœtus lugubris** Say.
- **Micromalthus debilis** Lec. n. g. and sp.

CUPESIDÆ.

- **Cupes capitata** Fab. Kalamazoo.
  - **concolor** Westw.

PTINIDÆ.

- **Ptinus fur** Linn.
  - **bimaculatus** Melsh.
- **Eucrada humeralis** Melsh.
- **Ernobius mollis** Linn.
- **Oligomerus sericans** Melsh.
- **Sitodrepa panicea** Linn.
- **Trichodesma gibbosa** Say.
- **Hadrobregmus errans** Mels.
  - **carinatus** Say.
  - **linearis** Lec.
- **Anobium notatum** Say.
- **Trypopitys sericeus** Say.
- **Petalium bistriatum** Say.
- **Xyletinus mucoreus** Lec.?
  - **fucatus** Lec.
  - **lugubris** Lec. n. sp.
- **Lasioderma serricorne** Fab.
- **Hemiptychus gravis** Lec.
  - **ventralis** Lec.
- **Protheca puberula** Lec.
- **Dorcatoma pallicorne** Lec.
  - **setulosum** Lec.
  - **incomptum** Lec.
- **Cænocara oculata** Say.
  - **scymnoides** Lec.
  - **intermedia** Lec.
- **Ptilinus ruficornis** Say.
- **Hendecatomus rugosus** Rand.
- **Sinoxylon bidentatum** Horn. p.544.
- **Bostrichus armiger** Lec.
  - **truncaticollis** Lec.

SPONDYLIDÆ.

Parandra brunnea Fabr.

CERAMBYCIDÆ.

Orthosoma brunneum Forst.
Tragosoma Harrisii Lec.
Asemum mœstum Hald.
Criocephalus obsoletus Rand.
Smodicum cucujiforme Say.
Dularius brevilineus Say.
Phymatodes variabilis Fabr.
  varius Fab.
  maculicollis Lec. n. sp. I.
Chion cinctus Dr.
Elaphidion incertum Newm
  villosum Fab.
  parallelum Newm.
  unicolor Rand.
Callimoxys fuscipennis Lec.
Molorchus bimaculatus Say.
Batyle ruber Lec.
Cyllene pictus Drury.
  Robiniæ Forst.
Calloides nobilis Say. H.
Arhopalus fulminans Fab.
Xylotrechus colonus Fab.
  sagittatus Germ.
  undulatus Say.
Neoclytus capræa Say.
  erythrocephalus Fab.
Clytanthus ruricola Oliv.
Microclytus gazellula Hald.
Cyrtophorus verrucosus Oliv.
Euderces picipes Fab.
Distenia undata Oliv.
Desmocerus palliatus Forst.
Encyclops cæruleus Say.
Centrodera decolorata Harr. H.
Acmæops bivittata Say.
Gaurotes cyanipennis Say.
Bellamira scalaris Say. H.
Typocerus velutinus Oliv.
  sparsus Lec. n. sp. E.
Leptura capitata Newm.
  zebra Oliv.
Leptura rubrica Say.
  proxima Say.
  vittata Germ.
  sphæricollis Say.
  vibex Newm.
  aspera Lec.
Psenocerus supernotatus Say.
Monohammus scutellatus Say.
  confusor Kby.
Dorcaschema nigrum Say.
Goes oculatus Lec.
Plectrodera scalator Fab. Lake Huron.
Acanthoderes decipiens Hald.
Leptostylus planidorsus Lec.
  commixtus Hald. H.
  macula Say.
Sternidius variegatus Hald.
  alpha Say
  cinereus Lec.
  Xanthoxyli Shimer.
Liopus signatus Lec.
  quercus Fitch.
  facetus Say.
Lepturgus symmetricus Hald.
Hyperplatys maculatus Hald.
Graphisurus fasciatus DeG.
  pusillus Kby.
Acanthocinus obsoletus Oliv.
Hoplosia nubila Lec.
Pogonocherus mixtus Hald. H.
Ecyrus dasycerus Say.
Eupogonius tomentosus Hald. H.
  vestitus Say.
  subarmatus Lec.
Saperda obliqua Say.
  cretata Newm.
  vestita Say.
  discoidea Fabr.
  tridentata Oliv.
  lateralis Fab.
  mœsta Lec. H.
  concolor Lec.
Oberea ocellata Hald.
  bimaculata Oliv.
Tetraopes tetraophthalmus Forst.

BRUCHIDÆ.

- **Bruchus pisi** Linn.
  - **alboscutellatus** Horn.
  - **distinguendus** Horn.
  - **calvus** Horn. var.
  - **Hibisci** Oliv.
  - **musculus** Say.
  - several unnamed or new species.

CHRYSOMELIDÆ.

- **Donacia piscatrix** Lac.
  - **tuberculata** Lac.
  - **hirticollis** Kby.
  - **proxima** Kby.
  - **subtilis** Kunze.
  - **pubescens** Lec.
  - **confusa** Lec.
  - **femoralis** Kby.
  - **jucunda** Lec.
  - **Kirbyi** Lec.
- **Macroplea Melsheimeri** Lac.
- **Orsodachna atra** Ahr. A.
- **Zeugophora scutellaris** Suffr.
  - **puberula** Cr. var. ?
  - **varians** Cr.
  - **consanguinea** Cr. *
- **Lema brunnicollis** Lac.
  - **trilineata** Oliv.
- **Chlamys plicata** Fab.
  - **cribripennis** Lec. n. sp. p.
- **Exema conspersa** Mannh.
- **Monachus saponatus** Fab.
- **Cryptocephalus congestus** Fab.
  - var. **sulphuripennis** Melsh.
  - **formosus** Mels.
  - **sellatus** Suffr.
  - **lituratus** Fab.
  - **venustus** Fab.
  - **Schreibersii** Suffr.
  - **dispersus** Hald.
  - **4-maculatus** Say.
  - **quadruplex** Newm.
  - **catarius** Suffr.
- **Cryptocephalus auratus** Fabr.
  - **atomus** Suffr.
  - **n. sp.**
- **Pachybrachys trinotatus** Melsh.
  - **M-nigrum** Melsh.
  - **subfasciatus** Hald.
  - **atomarius** Melsh.
  - **femoratus** Oliv.
  - **infaustus** Hald.
  - **tridens** Melsh.
  - **abdominalis** Say.
  - **hepaticus** Melsh.
- **Adoxus vitis** Linn. H.
- **Xanthonia 10-notata** Say.
  - **villosula** Melsh.
- **Heteraspis pubescens** Melsh.
- **Chrysochus auratus** Fab.
- **Paria 6-notata** Say.
- **Colaspis brunnea** Fab.
  - **prætexta** Say.
  - **tristis** Oliv.
- **Chrysomela clivicollis** Kby.
  - **10-lineata** Say.
  - **suturalis** Fabr.
  - **similis** Rog.
  - **elegans** Ol.
  - **multiguttis** Stål.
  - **philadelphica** Linn.
  - **Bigsbyana** Kby.
- **Gastrophysa Polygoni** Linn.
- **Prasocuris Phellandrii** Ill. H.
  - **varipes** Cr.
  - **obliquata** Cr.
- **Phyllodecta vulgatissima** Linn.
- **Plagiodera scripta** Fab.
- **Cerotoma caminea** Fabr.
- **Phyllobrotica decorata** Say.
  - **discoidea** Fabr.
- **Luperus meraca** Fabr.
- **Diabrotica 12-punctata** Oliv.
  - **vittata** Fabr.
- **Galeruca americana** Fab.
  - **Sagittariæ** Gyllh.
  - **decora** Say.
  - **notata** Fab.
- **Trirhabda canadensis** Kby.

Hypolampsis Clarkii Cr. H.
Œdionychis gibbitarsis Say.
vians Ill. var. **scripticollis** Say.
thyamoides Cr.
6-maculata Ill.
quercata Fabr.
scalaris Melsh.
Disonycha limbicollis Lec.
var. **pallipes** Cr.
alternata Ill.
triangularis Say.
collata Fabr.
Graptodera bimarginata Say.
carinata Germ.
exapta Say.
rufa Linn.
one unnamed species.
Longitarsus melanurus Melsh.
testaceus Lec.
several unnamed species.
Batophila spuria Lec.
Phyllotreta Zimmermanni Cr.
vittata Fab.
bipustulata Fabr.
robusta Lec. n. sp.
Dibolia ærea Melsh.
Systena frontalis Fabr.
marginalis Ill.
Crepidodera Helxines Linn.
atriventris Melsh.
Modeeri Linn.
Epitrix cucumeris Harr.
hirtipennis Melsh.
Mantura floridana Cr.
Chætocnema denticulata Ill.
parcepunctata Cr.
confinis Cr.
rudis Lec. n. sp. M.
protensa Lec.
flavicornis Lec.
Psylliodes punctulata Melsh.
Blepharida rhois Forst.
Stenispa metallica Fabr.
collaris Baly.
Odontota scapularis Oliv.
Odontota rubra Web.
rosea Web.
Microrhopala porcata Melsh.
Physonota unipunctata Say.
Cassida nigripes Oliv.
Coptocycla aurichalcea Fab.
guttata Oliv.
purpurata Boh.
clavata Fabr.

TENEBRIONIDÆ.

Nyctobates pensylvanica De G.
barbata Kn. H.
Merinus lævis Oliv.
Upis ceramboides Linn.
Haplandrus femoratus Fabr. Kalamazoo.
concolor Lec. H.
Scotobates calcaratus Fab.
Xylopinus saperdioides Oliv.
Tenebrio obscurus Fab.
molitor Linn.
castaneus Kn.
tenebrioides Beauv.
Blapstinus mœstus Mels.
interruptus Say.
Diœdus punctatus Lec.
Echocerus maxillosus Fab.
Uloma impressa Melsh.
mentalis Horn.
Paratenetus punctatus Sol.
gibbipennis Mots.
Diaperis Hydni Fab.
Hoplocephala bicornis Oliv.
Platydema excavatum Say.
ruficorne St.
americanum Lap.
picilabrum Mels.
subcostatum Lap.
Scaphidema æneolum Lec.
Hypophlœus parallelus Fab. H.
Pentaphyllus pallidus Lec.
Bolitotherus bifurcus Fab.
Bolitophagus corticola Say. H.
Rhipidandrus paradoxus Beauv.

Meracantha contracta Beauv.
Strongylium tenuicolle Say.

CISTELIDÆ.

Hymenorus pilosus Mels. var.
obscurus Say. var.?
punctulatus Lec.
niger Mels.
rufipes Lec. H.
Cistela brevis Say.
sericea Say.
Isomira 4-striata Coup.
Mycetochares Haldemani Lec.
foveata Lec.
tenuis Lec.
binotata Say. H.
longula Lec. n. sp.
lugubris Lec. n. sp.
analis Lec. n. sp.
marginata Lec. n. sp. M.
gracilis Lec. n. sp. M.
Capnochroa fuliginosa Melsh.
Androchirus luteipes Lec.

LAGRIIDÆ.

Arthromacra ænea Say.

PYROCHROIDÆ.

Pyrochroa flabellata Fab.
femoralis Lec.
Schizotus cervicalis Newm.
Dendroides canadensis Latr.
concolor Newm.

ANTHICIDÆ.

Corphyra Newmani Lec.
lugubris Say.
labiata Say.
terminalis Say.
elegans Hentz.
Notoxus anchora Hentz.
monodon Fab.
Tomoderus interruptus Laf.
Anthicus formicarius Laf.
Anthicus floralis Payk.
difficilis Lec.
scabriceps Lec.
cervinus Laf.
spretus Lec.
fulvipes Laf.
coracinus Lec.
pallens Lec. H.
granularis Lec.
n. sp.
Xylophilus piceus Lec.
fasciatus Mels.
signatus Hald.
basalis Lec.
n. sp.?

MELANDRYIDÆ.

Canifa plagiata Mels.
pallipes Mels.
pallipennis Lec. n. sp. **M.**
Penthe obliquata Fabr.
pimelia Fabr.
Synchroa punctata Newm.
Emmesa labiata Say.
Melandrya striata Say.
Spilotus 4-pustulosus Melsh.
Mystaxis simulator Newm.
Serropalpus striatus Hellen. H.
Dircæa liturata Lec.
fusca Lec. n. sp. **M.**
Symphora flavicollis Hald.
Hallomenus scapularis Mels.
debilis Lec.
serricornis Lec. n. sp. M.
Eustrophus confinis Lec.
bicolor Say.
bifasciatus Say.
tomentosus Say.
Orchesia castanea Melsh.
gracilis Melsh.

MORDELLIDÆ.

Pentaria trifasciata Melsh.
Anaspis flavipennis Hald.

Anaspis rufa Say.
    n. sp.?
Mordella melæna Grav.
    scutellaris Fab.
    irrorata Lec.
    baltimorensis ‡ Zimm.
    marginata Mels.
    lineata Mels.
    undulata Mels.
Glipodes helva Lec.
Mordellistena trifasciata Say.
    lutea Mels
    ornata Mels.
    scapularis Say.
    tosta Lec.
    picicornis Lec.
    cervicalis Lec.
    fulvicollis Mels.
    impatiens Lec.
    nigricans Mels.
    guttulata Hellm.
    pustulata Mels.
    convicta Lec.
    ambusta Lec.
    marginalis Say.
    fuscata Mels.
    discolor Mels.
    n. sp.
Myodites Walshii Lec.

MELOIDÆ.

Meloe rugipennis Lec.
Macrobasis unicolor Kby.
Epicauta Convoluli Mels H.
    vittata Fabr.
    cinerea Forst.
    pensylvanica De G.

ŒDEMERIDÆ.

Ditylus cœruleus Rand. Lake Huron
Asclera ruficollis Say.
    puncticollis Say.

MYCTERIDÆ.

Lacconotus punctatus Lec.

PYTHIDÆ.

Salpingus virescens Lec.
    two other species. ?
Rhinosimus nitens Lec.

RHYNCHITIDÆ.

Auletes ater Lec. H.
    Cassandræ Lec.
Eugnamptus angustatus Gyllh.
    var. **collaris** Gyllh.
Rhynchites æneus Boh.
    cyanellus Lec.
Pterocolus ovatus Gyllh.

ATTELABIDÆ.

Attelabus analis Ill.
    Rhois Boh.

OTIORHYNCHIDÆ.

Hormorus undulatus Uhler. Lake Huron.
Panscopus erinaceus Say.
Aramigus grisea Horn.
Phyxelis rigidus Say.
Otiorhynchus ligneus Oliv.
Cercopeus chrysorrhœus Say.
Pandeleteius hilaris Hbst.
Cyphomimus dorsalis Horn.

CURCULIONIDÆ.

Sitones flavescens Marsh.
    tibialis Germ.
Ithycerus noveboracensis Forst.
Phytonomus comptus Say.
    nigrirostris Gyllh.
Lepyrus geminatus Say.

Listronotus tuberosus Lec.
callosus Lec.
inæqualipennis Boh.
caudatus Say.
appendiculatus Boh.
frontalis Lec.
latiusculus Boh. H.
Macrops solutus Boh.
several unnamed species.
Hypomolyx pinicola Coup. H.
Hylobius pales Boh. H.
confusus Kby.
Pissodes Strobi Peck. H.
Lixus rubellus Rand.
rectus Lec.
mucidus Lec.
concavus Say.
Grypidius Equiseti Gyllh.
Erycus puncticollis Lec.
Dorytomus laticollis Lec.
brevicollis Lec.
luridus Mannh.
Acalyptus Carpini Linn.
Desmoris constrictus Say.
Pachytychius discoideus Lec.
Smicronyx ovipennis Lec.
tychioides Lec.
vestitus Lec.
squamulatus Lec.
Endalus limatulus Lap.
ovalis Lec.
Tanysphyrus Lemnæ Gyllh.
Onychylis nigrirostris Boh.
longulus Lec.
Anchodemus angustus Lec.
Hubbardi Lec.
Schwarzi Lec.
Lissorhoptrus simplex Say.
apiculatus Gyllh.
Bagous mamillatus Say.
obliquus Lec.
americanus Lec.
magister Lec.
nebulosus Lec.
bituberosus Lec.
transversus Lec.
Otidocephalus Chevrolati Horn.
perforatus Horn.
Magdalis hispoides Lec. H.
barbita Say.
olyra Hbst.
salicis Horn.
inconspicua Horn.
pandura Say.
armicollis Say.
pallida Say.
Anthonomus 4-gibbus Say
nebulosus Lec.
scutellatus Gyllh.
signatus Say.
rubidus Lec.
sycophanta Walsh.
rufipennis Lec.
suturalis Lec.
n. sp. near **flavicornis.**
corvulus Lec.
disjunctus Lec.
cratægi Walsh.
n. sp. near **cratægi.**
decipiens Lec.
Orchestes pallicornis Say.
niger Horn.
subhirtus Horn.
ephipiatus Say.
Elleschus ephipiatus Say.
Prionomerus calceatus Say.
Piazorhinus scutellaris Gyllh.
Proctorus decipiens Lec.
Plocetes Ulmi Lec.
Gymnetron teter Schh.
Conotrachelus albicinctus Lec.
nenuphar Harr.
seniculus Lec.
elegans Boh.
Cratægi Walsh.
posticatus Boh.
anaglypticus Fahr.
Rhyssematus lineaticollis Say.
Zaglyptus striatus Lec.
Acamptus rigidus Lec.
Acalles sordidus Lec. A.
Tyloderma foveolatum Say. H.

Tyloderma variegatum Horn.
æreum Say.
Cryptorhynchus parochus Say.
bisignatus Say.
fuscatus Lec.
fallax Lec.
ferratus Say.
Piazurus oculatus Say.
Copturus quercus Gyllh.
Acoptus suturalis Lec.
Mononychus vulpeculus Boh.
Craponius inæqualis Say.
Cœliodes acephalus Germ.
asper Lec.
cruralis Lec.
nebulosus Lec.
Acallodes ventricosus Lec.
Ceuthorhynchus Rapæ Gyll.
sulcipennis Lec.
decipiens Lec.
pusio Mannh.
semirufus Lec.
puberulus Lec.
Erysimi Fab.?
n. sp.
Phytobius velatus Gyllh.
Pelonomus sulcicollis Fahr.
squamosus Lec.
Cœlogaster Zimmermanni Lec.
cretura Hbst.
Rhinoncus pericarpius Gyllh.
pyrrhopus Boh.
longulus Lec.
Trichobaris trinotata Say.
Baris striata Say.
tumescens Lec.
Pseudobaris nigrina Say.
T-signum Boh.
Ampeloglypter Sesostris Lec.
ater Lec.
Madarus undulatus Boh.
Stethobaris corpulenta Lec.
Centrinus scutellum-album Say.
rectirostris Lec.
prolixus Lec.
confinis Lec.
Zygobaris conspersa Lec.
subcalva Lec. n. sp.
Barilepton cribricolle Lec.
quadricolle Lec.
filiforme Lec.
Balaninus uniformis Lec.
nasicus Lec.

BRENTHIDÆ.

Eupsalis minuta Drury.

CALANDRIDÆ.

Sphenophorus ochreus Lec. Lake Michigan.
pertinax Oliv. South Haven.
robustus Horn. South Haven.
costipennis Horn.
cariosus Oliv.
sculptilis Uhler.
melanocephalus Fab.
placidus Say.
Rhodobænus 13-punctatus Ill.
Calandra Oryzæ Fabr.
Dryophthorus corticalis Say.
Cossonus concinnus Boh.
n. sp.
Allomimus dubius Horn. A.
Phlœophagus apionides Horn.
minor Horn.
Rhyncolus oregonensis Horn.
Stenoscelis brevis Boh.

SCOLYTIDÆ.

Monarthrum fasciatum Say.
mali Fitch.
Pityophthorus materiarius Fitch.
minutissimus Harr.
cariniceps Lec.
puberulus Lec. H.
consimilis Lec. n. sp.
hirticeps Lec. n. sp. M.
pusio Lec. n. sp. M.
opaculus Lec. n. sp. M.

Xyloterus politus Say.
Xyleborus celsus Eichh.
 fuscatus Eichh.
 biographus Lec
 xylographus Zimm. Lansing.
 cælatus Zimm.
 punctipennis Lec. n. sp. M.
Dryocœtes septentrionis Mannh.
 affaber Mannh.
Xylocleptes decipiens Lec. n. sp.
Cryphalus rigidus Lec.
Tomicus pini Say. H.
Micracis suturalis Lec.
 rudis Lec.
 opacicollis Lec. n. sp.
 asperulus Lec. n. sp.
Chramesus Icoriæ Lee.
Phlœotribus liminaris Harr. Lansing.
Hylesinus aculeatus Say.
Hylesinus opaculus Say.
Dendroctonus similis Lec. H.
Hylurgops pinifex Fitch. H.

ANTHRIBIDÆ.

Eurymycter fasciatus Oliv.
Hormiscus saltator Lec.
Eusphyrus Walshii Lec.
Cratoparis lunatus Fab.
Brachytarsus tomentosus Say.
 variegatus Say.
Choragus Harrisii Lec. n. sp.
Euxenus punctatus Lec.

APIONIDÆ.

Apion rostrum Say.
 several unnamed species.

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4. *Description of the Larva of* MICROMALTHUS DEBILIS *Lec.*

BY H. G. HUBBARD.

Color transparent white, mandibles and anal appendage castaneous.

Form cylindrical, very slightly flattened beneath, hardly narrowed laterally in front and behind. Body glabrous, except a few hardly visible hairs upon the sides, without legs. Length 0.10–.12 inch.; width about 0.03 inches.

Head not quite as broad as the segments of the abdomen, convex, transverse, enlarged posteriorly; sides rounded, convex; anterior border nearly straight, posterior border emarginate; above and below a few long bristles. No ocelli.

Antennæ short, inserted in depressions on the anterior angles of the head, of four joints increasing in length, the first very short, transverse, the second smaller, about as long as broad, the third longer than the preceding, with a short oval lobe below, before the tip, the fourth twice as long as the third, slender, blade-shaped, tipped with a minute spine.

Labrum transverse, somewhat enlarged anteriorly, borders nearly straight, anterior angles rounded, with long stout spines above and below. Mandibles as long as the antennæ, stout, curved, three-toothed with a large hatchet-shaped basal lobe, obliquely ridged upon the under surface.

Maxillæ, very large and prominent, longer than the mandibles; with palpi of three joints, the first and second short, cylindrical, the third as long as the first and second united, more slender, flat, and divided nearly to the base into two superimposed lobes bearing papillæ; maxillary lobe divided anteriorly by a deep notch into two portions, the apical, smaller and narrower than the basal, blade-shaped, tipped with a long slender spine, and bearing four long and stout teeth projecting at right angles to the lobe, like the blades of a half-opened penknife; the basal portion with two rows of teeth on the border, and a slender tooth and bristle at the apex.

Labium consisting firstly, of an elongated, triangular mentum, with the apex thickened in a conical protuberance, bearing a pair of bristles near the middle, and another pair upon the thickened tip; secondly, of a transverse palpiger, bearing small fleshy palpi of two subequal joints, and its anterior border prolonged between them in a conical projection; thirdly, of an elongated, convex, corneous ligula, enlarged anteriorly, with straight borders and a pair of bristles near the tip. Behind and above the mentum and plainly seen through the transparent tissues, is a broadly triangular, horny piece, the base of which extends between the hinges of the mandibles, and the apex reaches as far as the middle of the ligula; upon the upper surface oblique grooves on each side correspond with the ridges upon the basal lobes of the mandibles, into which they lock when the mandibles are closed.*

Thoracic segments slightly thicker than the abdomen, the first longer, the two following subequal in length.

Abdomen cylindrical or slightly depressed, of nine segments, the first eight subequal, transverse, each with a few long bristles, the ninth conical, scatteringly covered with long bristles, terminating abruptly in two minute toothed appendages, one proceeding from the dorsal surface, and arching downwards, the other from the ventral surface, curving upwards, and resembling two hands with partly extended fingers, having the palms turned towards each other. The upper and longer appendage appears to be tubular for one-third of its length from the base, the remainder is concave beneath, and terminates in two terminal and six lateral teeth, directed downwards, their bases forming longitudinal ridges on the concave under surface. The lower appendage is shorter, more strongly curved, and in the opposite direction, concave above, expanded into a palm at the end, with eight teeth as in the preceding; the concave upper surface is distinctly denticulate.

The larva lives in damp situations, in the soft, crumbling wood of old oak logs, which have become entirely disintegrated and colored dark red, probably by a microscopic fungus. A number of larvæ, pupæ, and imagos were found together in a small portion of such a log on August 17th, 1874, at Detroit, Michigan.

As Dr. LeConte has placed this insect in the family Lymexylidæ, it will be interesting to compare its larva with that of *Hylecœtus lugubris* Say, specimens of which are before me. The larvæ of *Hylecœtus* were taken from cylindrical burrows in the solid wood of the American linden. It

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* This piece and the mandibles, the forms and relative positions of which are shown in fig. 9 of the plate, though very conspicuous in dissections under the microscope, are omitted in fig. 5 in order to avoid obscuring overlying parts.

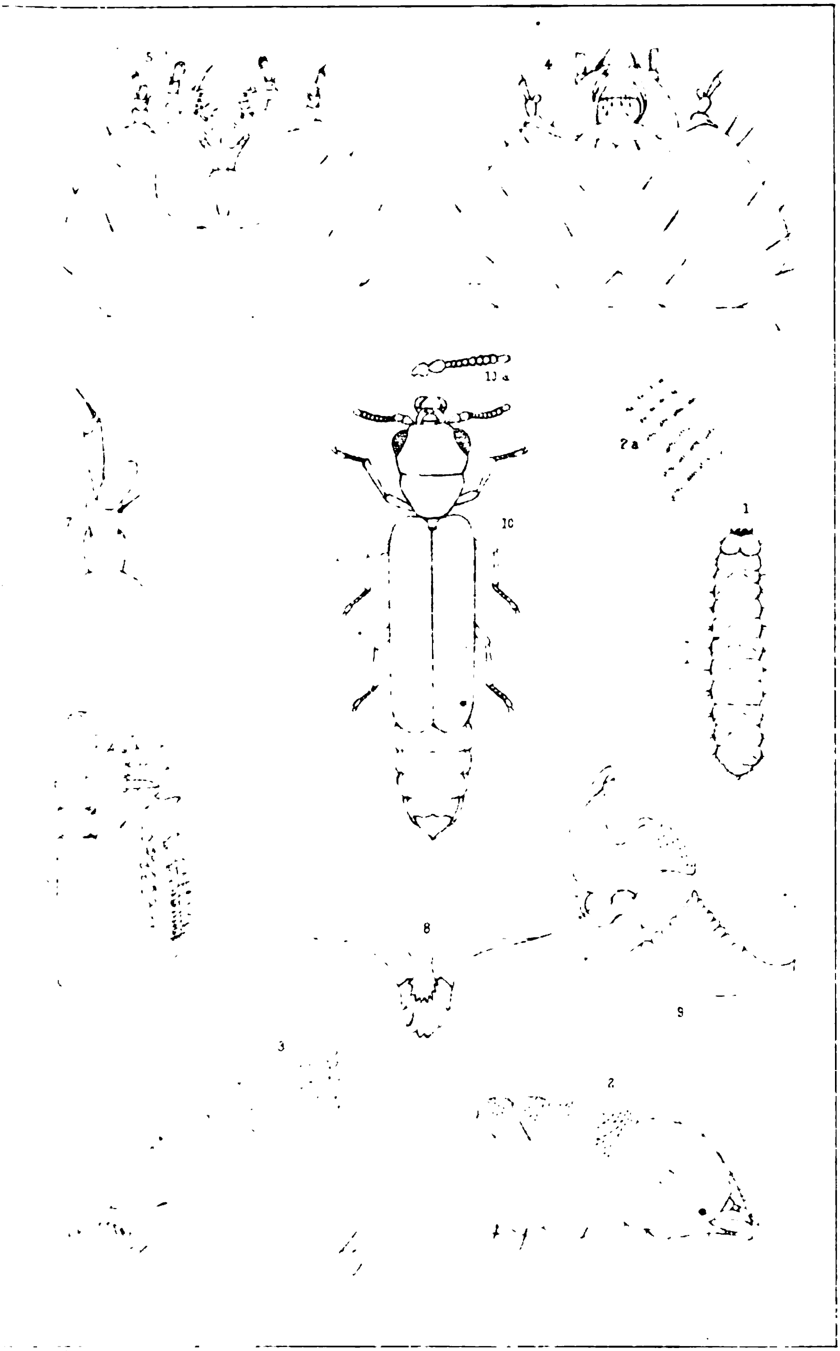
has a cylindrical body of twelve segments; a globular head, with two large ocelli, which are, however, covered by the epidermis; the first thoracic segment is enlarged, and partly covers the head, like a hood; the three thoracic segments bear well-developed legs; and the abdomen terminates in a long tapering style, toothed and concave on the upper surface, and turning upwards at the end; the stigmata are large and in their normal positions, one pair beneath, on the thorax, and eight pairs on the sides of the abdominal segments.

The antennæ are four-jointed, exceedingly minute and stout, and, as in *Micromalthus*, have the third joint lobed beneath, an apical spine, and occupy similar positions on the anterior angles of the head; the maxillæ also have the lobe divided into an upper and lower portion, although the separation is not very distinct, and appears under the lens as a corneous line, the spines upon the lobe are slender and not markedly different upon the two portions. The labrum and labium are stout and thick, but do not present important structural differences from the same parts in *Micromalthus*. The mandibles are simple or slightly notched, the basal lobes not prominent, but finely ridged, and closing upon a triangular corneous piece which lies above the mentum. All the parts of the mouth in *Hylecœtus* are smaller, stouter, and simpler in their structural details than the corresponding organs in *Micromalthus*, differences which perhaps have some relation to the harder material in which the former lives. Notwithstanding the striking difference in their external forms, the important structural analogies between the antennæ and mouth parts, seem to indicate a relationship between these two larval forms.

Explanation of Plate 15.

Micromalthus debilis Lec., Imago, central figure.
1. " " " Larva, enlarged twelve times.
2.—Head and thoracic segments, lateral view; much enlarged.
3.—Terminal segments, showing the anal appendages, lateral view.
4.—Head from above, very much enlarged.
5.—Head from below, with mandibles omitted.
6.—Right maxilla, seen from below.
7.—Right antenna, from below.
8.—Anal appendages, seen from below, very much enlarged.
9.—Corneous triangular piece lying above the mentum, with the left mandible thrown back, seen from above; the ridges upon the under surface of the mandible are indicated by dotted lines.

NOTE—For the sake of distinctness, the appendages in fig. 3 are drawn too large in proportion to the segments. The proportions are more correctly given in figs 1 and 8.



[illegible] Hubbard, del.

Micromalthus debilis Lec. and larva.

UNIV. OF MICH.

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Hyner's Station Oil Well Section, included in a Detailed Section of the Rocks Between the Lower Productive Coal Measures (XIII), and the Dark Slates of the Devonian (VIII) in the Vicinity of Renovo, Clinton Co., Pennsylvania.

BY H. M. CHANCE.

(Read before the American Philosophical Society, May 3d, 1878.

The order of the Coal Rocks of the section was determined by Mr. C. A. Ashburner, by a survey made near Renovo, in 1875. The lower part of the section is taken from a record (kept by Mr. Jas. David) of a well drilled for oil near Hyner Station on the P. & E. R. R. The remainder of the section is supplied by several intermediate sections of the surface exposures between Renovo and Hyner. The total thickness of measures described amounts to 3460 feet, grouped as follows:

Lower Productive Coal Measures; Sandstone shale, fire-clays, etc., with four (4) workable beds of coal	212′
Massive Sandstones, parted by shale, and thin bedded sandstones. The sandstones of this group are white to yellowish-gray in color, massive, hard, and coarse grained, causing prominent topographical features. The whole mass in all of its features resembles the Conglomerate (No. *XII*)	245′
Greenish-gray thin bedded Sandstones, generally fine grained, with some brownish mottled sandstones, and some micaceous beds separated by softer measures—shales and slates—with an occasional red band	390′
Greenish-gray Sandstones, laminated and fine grained, with an occasional band of red sandstone, and a large percentage of micaceous beds alternating with red and olive-gray shales. Red is very prominent down to the mouth of the well	630′
Red Sandstone and shale with occasional bands of gray sandstone and shale (Lower Catskill?)	796′
Slates and Shales, bluish in color, with some sandy bands to the bottom of the well (Chemung?)	1187′
Total thickness of rocks described in section	3460′

Detailed Section.

Concealed	15′
Coal (5) of Mr. Ashburner's provisional numbers	4′
Concealed	92′
Coal (4) (3 feet 2 inches measured)	3′
Fire-clay with "kidney ore."	10′
Shale and Shaly S. S	15′
S. S., coarse grained	26′
Concealed	4′
Coal (3)	4′
Concealed	26′
S. S., gray	10′
Coal (2) (3 feet 2 inches measured)	3′
	212′

S. S., gray, hard, "upper part S. S., lower part shale."	33′
Coal (1)	1′
Conglomerate	25′
Concealed. Mr. Ashburner states that some red shale has been found here	41′
S. S. hard, gray, coarse grained	25′
S. S. white and gray, thin bedded, with some shale	40′
S. S. hard, very dark gray	20′
Concealed	25′
S. S. coarse and loose grained, gray	35′
	245′
Concealed—trace of red	65′
S. S. hard, thin bedded, grayish steel color	25′
S. S. brownish, fine grained; micaceous, with shale and traces of red; poorly exposed	50′
S. S. fine grained greenish-gray	20′
S. S. very fine grained and thin bedded, gray	20′
Shales, with shaly micaceous brownish sands—poorly exposed—traces of red	45′
S. S. mottled, browish, micaceous and flaggy, in two members parted by shale	75′
Shale; with some fine grained greenish-gray S. S	90′
	390′
S. S. and Shale, red and olive, fine grained and micaceous	20′
S. S. greenish-gray, with shale	70′
S. S. fine grained red and gray alternating with shale	175′
S. S. red, with a little gray interbedded	25′
S. S. greenish-gray	15′
S. S. red	20′
Concealed	35′
S. S. greenish-gray, hard, with some red bands	30′
Concealed	20′
Shale and S. S. red	10′
Concealed	10′
S. S. fine grained greenish-gray	10′
Concealed	20′
S. S. fine grained greenish-gray	10′
Concealed	10′
S. S. red, mostly fine grained and shaly	30′
Concealed	30′
S. S. hard, dark gray mottled with brown	5′
Concealed	25′
Shale and S. S. red	30′
Concealed to *mouth of well*	30′
	630′

"Stone and wash;" Drift (local) (*floor of derrick*)	50′
Red rock "with iron."	30′
Gray rock, hard and dark.	15′
Red rock partly shales	22′
Gray with mica	16′
Red rock, hard	5′
Red rock, salt water	32′
"Copper rock" of the miners	4′
Red rock, salt water	10′
Gray rock, "	16′
S. S. red, *gas*	46′
Red rock with shales, *gas*	52′
Gray rock, *very hard*	11′
Red rock with gray shales	115′
S. S	4′
S. S. red	111′
Gray rock	8′
Shale, red and sandy, *gas*	37′
Gray rock, dark with some sandy bands	95′
Red rock, "*some oil.*"	35′
Shale, sandy and gray, "partially hard."	35′
Shale; red, *some oil*	10′
Gray rock with sand	30′
Shale red	7′
	796′
Shale and S. S. alternating, blue	67′
S. S. fine and white	25′
Slate; blue	38′
S. S. and blue slate alternating	96′
S. S. white	6′
S. S. blue, very hard	55′
S. S. and Shale, blue and very hard	92′
S. S. and Shale; blue	30′
S. S. brown and white, *oil and gas*	5′
S. S. dark blue, with shale	165′
S. S. dark blue, with white sand shells	10′
Sand shale, soft and blue	33′
Shale, blue, with brown and black sand shells	125′
Shale; soft blue	150′
S. S. white, *with oil**	46′
Shale, sandy; blue	25′
Sandy shelly rock, blue	219′
	1187′
Depth of Well by addition	1983′
Depth of Well reported by Mr. David	1978′
Total Thickness of Measures in the Section	3460′

*The quantity of oil is not stated, and the well is not considered productive.

Synopsis of the Fishes of the Peruvian Amazon, obtained by Professor Orton during his Expeditions of 1873 *and* 1877.

By E. D. Cope.

(*Read before the American Philosophical Society, May* 17*th*, 1878.)

The present paper consists of a catalogue of one hundred and twenty species of fishes which were obtained by the late Professor James Orton, from the head streams of the Amazon. The localities from which the specimens were derived, are the following: Cuzco, on the Urubamba near the head of the Ucayale; Moyabamba and Balsa Puerto on or near the lower course of the Huallaga; Nauta on the Marañon at the mouth of the Ucayale, and Pebas below the mouth of the Napo. The larger part of the collections of 1873 came from Nauta, while those of 1877 were partly obtained near Pebas. The specimens from the Urubamba are the only ones taken at a great elevation, that of 11,000 feet. A recapitulation will be given at the close of the Catalogue. The collections contain numerous species previously known, as well as a number of interesting novelties.

HOLOSTOMI.

Symbranchidæ.

1. **Symbranchus marmoratus** Bloch.
Coll. 1873.

NEMATOGNATHI.

Hypophthalmidæ.

2. **Hypophthalmus edentatus** Spix.
Coll. 1873.

3. **Hypophthalmus perporosus**, sp. nov.

Established on a rather large specimen in good preservation. Radii; D. I. 6; A. 67; V. I. 5. The dorsal fin is small, and is situated 35 mm. nearer the end of the muzzle than the base of the superior fulcra of the caudal fin; it originates above the seventh ray of the anal fin. The extremities of the ventrals do not extend beyond those of the pectorals. The spine of the latter is very weak, although longer than that of the dorsal, and is one-third the length of the head. The head enters the length minus the caudal fin four and one-seventh times, and is just equal to the depth of the body at the anterior part of the anal fin. The eye is one-thirteenth the length of the head, and one-sixth the length of that part of the head anterior to it. The fissure continued from the canthus oris extends to below its center. One eye is a little more elevated than the other, the one having some inferior range, the other none. The maxillary barbels commence nearer to the angle of the mouth than to the base of the posterior mental barbels, and extend to a little beyond the base of the ventral fin. The mental barbels are on nearly a transverse line, and are broadly margined posteriorly; they are sub-equal in length, and when extended reach nearly to the opercular border. A peculiarity of this species, which I do not find in the *H. edentatus*, is the porosity of the skin. A series of pores extends along each border of each myocomma, forming double rows, extending from the dorsal to the ventral line 3 mm. apart. The pores in each row are from one to two millimeters apart.

The general color of this species is silvery, with the head and dorsal region lead colored. Total length M. .500 ; of head .108 ; to the line of the base of the anal .160 ; to base of caudal fin .435.

Probably from Nauta.

SILURIDÆ.

4. SORUBIM LIMA Bl., Schn.

Coll. 1873–77.

5. PLATYSTOMA FASCIATUM Linn. From Nauta, coll. 1873.

I find the anal rays of the specimen to count II–9; Dr. Günther gives 14.

6. HEMISORUBIM PLATYRHYNCHUS Cuv. Val.

Coll. 1877.

7. PHRACTOCEPHALUS HEMLIOPTERUS Schn.

Coll. 1877.

8. PSEUDORHAMDIA PISCATRIX Cope, Proceed. Amer. Philos. Soc., 1870, p. 569.

Coll. 1877.

9. PIMELODUS HUMILIS Gthr., Catal. Fishes, Brit. Mus. v 129.

A specimen of about the size of those described by Dr. Günther agrees with them very closely in all important respects. There are some differences, however, which should be noted, especially since the typical specimens are said to have come from Venezuela. In the latter the distance between the dorsal fins is said to equal two-thirds the length of the adipose fin : in my specimen this space equals two-fifths the length of the adipose. The diameter of the eye in the former is described as one-half the width of the interorbital space ; in the Peruvian specimen, the diameter of the eye is a little more than one-third the same dimension. There is a dark cloud at the base of the rayed dorsal fin, whose superior border is abruptly contrasted with the paler color above it. The anterior part of caudal region is a little more elevated than the dorsal region.

From Rioja, near Moyabamba, coll. of 1873.

10. PIMELODUS BATHYURUS, sp. nov.

Head covered with thin skin, and not granular, but somewhat ridged above. Supraoccipital process long and narrow, not reaching the basal bone of the dorsal spine ; adipose fin contained 4.3 times in the length minus the caudal fin. The caudal portion of the fish is considerably deeper than the abdominal, entering the length (less the caudal fin) six and three-tenth times. The head (to the opercular border) enters the same three and one-half times ; it is flat and rather elongate, and the mandible projects beyond the premaxillary border. The eye's diameter is just half the interorbital width. The maxillary barbels exceed the length of the fish; and the posterior mandibulars reach to a point below the middle of the dorsal fin.

Radial formula; D. I. 6; A. 9. Dorsal spine very slender, smooth, and not so long as the pectoral spine. The latter is as long as from the premaxillary border to the middle of the orbit; it is finely serrate on both edges. Operculum roughened with radiating lines; supraoccipital process six times as long as wide. Total length M. .070, interorbital width .007; length of base of rayed dorsal .008. Color uniform plumbeous.

Collection of 1877; two specimens.

11. PIMELODUS OPHTHALMICUS, sp. nov.

Head covered with a thin skin above which is involved in osseous wrinkles on the post frontal region. Supraoccipital process four times as long as wide, reaching the basal bone of the dorsal spine. Length of adipose fin contained 2.8 times in the length minus the caudal fin. Form quite slender; the greatest depth (which is at the middle of the dorsal fin) entering the length (minus the caudal) 6.5 times. The length of the head enters the same 4.75 times. The maxillary barbels reach to the middle of the anal fin, and the posterior mentals to the middle of the pectoral fin.

The eye is large, entering the length of the head three and three-eighth times, and exceeding the interorbital width by 2 mm. The upper lip projects a little beyond the lower. The two dorsal fins are separated by a space about equal to three-fourths the base of the anterior fin. The latter is higher than the depth of the body, and nearly equal to the length of the head; the spine is slender, and finely dentate on both edges. The pectoral spine is finely serrate on both edges and is nearly five-sevenths the length of the head. Radial formula; D.I. 6; A. 13; V. 6; P. I. 8. Humeral process extending to middle of pectoral spines, striate grooved. Axillary pore present. Color brown lead-color; top of head blackish; dorsal fin brown at base, then clear, then blackish. Total length M. .145.

Coll. of 1873.

This species belongs to the group with *Pimelodus cristatus*, *P. elongatus*, *P. agassizii*, *P. wesselii*, etc. It appears to approach most nearly the first named, but that fish has, according to the descriptions, fifteen anal rays, and the mental barbels extend beyond the extremity of the pectoral fins. Günther also states that its dorsal fin is nearly twice as high as long, which is not the case in my specimen, and the dorsal spine is not so long in the latter, being only three-fourths as long as the head instead of equal to it. The *Pimelodus cyanostigma* (*Rhamdia cyanostigma* Cope, Proceed. Amer. Philos. Soc. 1870, p. 569) is an allied species; but it has a shorter adipose fin, which enters the length three and one-fourth times, and which is separated from the rayed dorsal by a space equal to the length of the latter. Its maxillary barbels are also longer, extending to the end of the adipose fin.

12. PIMELODUS BUFONIUS Cuv. Val.

Coll. 1873–1877.

13. CALLOPHYSUS LATERALIS Gill.
Coll. 1877.

14. AGENIOSUS BREVIFILIS Cuv. Val.
Coll. 1873.

15. EUANEMUS NUCHALIS Spix.
Coll. 1873–1877.

16. EUANEMUS BRACHYURUS, sp. nov.

A single specimen of this species compared with three of the *E. nuchalis*, exhibits the following differential characters: With the head and abdomen of about the same length, the caudal region is only two-thirds as long; hence the anal fin is shorter, and is supported by fewer rays. The dorsal spine is materially longer and stronger. The head is much wider than in a *E. nuchalis* of the same total length. The teeth are much more numerous, forming wide bands on the dentaries, and a well-defined premaxillary band. The humeral process is naked; in *E. nuchalis* it is covered by a soft skin.

The depth at the first anal ray is one-sixth the length less the caudal fin. The length of the head enters the same 4.8 times. The length of the eye enters the head three times, and the interorbital width, one and two-third times. The dorsal spine is weakly serrate behind, smooth in front. The pectoral spine is strongly serrate behind, and is smooth in front; it is about as long as the head, and one quarter longer than the dorsal spine. Radii D. 1.7; C. + 17 +; A. 37; V. 14, the first ray enlarged; P. I. 12. The inner rays of the ventral fins adhere to the integument of the abdomen, but not to those of the opposite fin. The ventrals are wider than the pectorals and nearly reach the anal fin; the pectoral spines do not reach the base of the ventrals. The humeral process is smooth, and reaches the end of the basal fourth of the spine. The maxillary barbels reach nearly to the extremity of the pectoral spine, while the anterior mentals reach to the base of the same.

Total length. M. .145; of head .025; do. to base of anal fin .070; of base of anal fin .040. Lead-colored, sides of abdomen silvery; base of caudal fin blackish, the color extending into the superior and longer lobe.

17. AUCHENIPTERUS BREVIBARBIS, sp. nov.

Form robust; length of head entering total, without caudal fin, a little over four times; the depth of the body at the ventral fins entering the same five times. Head above coarsely granular, frontal fontanelle reduced to a small round hole. Mandible projecting a little. Anterior mental barbel as long as three diameters of the eye; the posterior not reaching the line of the posterior border of the operculum. Maxillary barbel reaching to the middle of the pectoral spine. Diameter of eye less than one sixth the interorbital width. Humeral process half as long as pectoral spine. Lateral postemporal process decurved so as to be nearly in contact with the middle of the humeral process.

Radial formula: D. I. 5; P. I. 6; V. 7; A. 22–3. Dorsal spine very robust, denticulated in front; pectoral spines twice as long, equaling (axial) length of head, robust, and serrate on both edges. Their extremities extend behind the line of the last dorsal ray, but do not reach the origin of the ventral fin. Caudal fin truncate with a slight obliquity inwards and downwards. Total length M. .230; of dorsal spine .023; of pectoral fin .045. Color above blackish, below brown; lower part of sides, chiefly behind pectoral fin with dark spots on the brown ground.

This robust species is related to such as the *A. obscurus* Gthr., but differs from them in the short beards, fewer fin rays and other characters.

Coll. 1877.

18. **Auchenipterus isacanthus**, sp. nov.

Head rather wide, not steeply shelving at the sides posteriorly, and finely rugose above, without a dermal layer, so that the segmentation of the bones is distinctly visible. Its length enters the total (less caudal fin) four times; which is an expression of the robust form of the fish. The body is highest at the front of the anal fin. Radii D. I. 5; A. 22; V. 7. Dorsal and pectoral spines of equal length and a little shorter than the length of the head, both serrate on both edges, the dorsal much the more finely. Eye obscure; operculum covered with smooth skin. Anterior mental barbels about equal to diameter of orbit; maxillary barbels reaching end of pectoral spine. Mandible projecting a little beyond premaxillary. Humeral process reaching beyond the middle of the pectoral spine, its surface coarsely striate, the striæ nodular. No thoracic dermo-ossification. Anal fin with nearly straight free border. Total length .085; of head above .025; of dorsal spine .016; interorbital width .011. Uniform lead color; dorsal fin with a black spot above.

This species is much smaller than the last, and very different in many respects, although it agrees with it in the rugosity of the head. It has, however, a large fontanelle open in front, while that of the *A. brevibarbis* is very small, and completely enclosed.

Two specimens; Coll. 1877.

19. **Centromochlus heckelii** Filippi.

Coll. 1877.

20. **Epapterus dispilurus**, gen. et sp. nov.

Char. Gen. Group *Doradinæ* of Gunther, with anterior dorsal fin in front of the ventrals, and gill membranes confluent with that of the throat. No adipose fin; soft portion of dorsal rudimental. Six barbels; teeth wanting from jaws and palate. Dorsal and pectoral spines present; ventral fins united to each other and to the middle line of the belly. Anal fin long, distinct from the caudal.

This new genus is related to *Euanemus*, but is distinguished by three characters, viz: (1) absence of adipose fin; (2) absence of teeth, and (3) rudimental soft part of first dorsal fin. The rudimental character of the teeth in *Euanemus nuchalis* offers an approximation to the edentulous condition of *Epapterus*.

Char. Specif. The proportions are elongate and the head is short, entering the length less the caudal fin six times. The anal fin is long, extending far forward, and the greatest depth of the fish is at its anterior part. This is a little more than one-fifth the length (less the caudal fin). The head is narrow, and rises rather steeply to the base of the dorsal spine without interruption. The supraoccipital process is rather wide, and continuous with the basal bone of the dorsal spine. The latter is bifurcate and sends a process outwards and backwards behind the base of the spine. The frontal fontanelle is long, and the head is covered with smooth skin. The eye is large and without free dermal border; its diameter enters the length of the head to the opercular border three and one-third times, and the interorbital width one and two-third times. The superciliary and prefrontal borders are prominent and form together an acute angle. The supraoccipital region is not keeled, but its sides form a steep roof.

Radii D. I.; A. 61; C. + 17 +; V. 15; P. I. 13. The dorsal spine is slender and nearly as long as the pectoral. It is directed somewhat forwards, and is entirely smooth. The caudal fin is notched to half its depth, and is rather small. The ventrals are large, and are united by the entire length of their inner rays. The external or first ray of each, is larger than the others, and the apex of the fin reaches the first anal ray. The closed pectoral spine barely reaches the base of the ventral; it is set with recurved teeth behind, but is smooth in front. The soft part of the fin is contracted and is much smaller than that of the ventral fin. The humeral process is short and smooth and is covered by a smooth skin; the postcoracoid processes are rather long and are very acute at the apex.

The maxillary barbels continue from the extremity of the long maxillary bone to the middle of the pectoral spine; the anterior ventrals, which are very little in advance of the posterior ventrals, reach the base of the same. The eyes have nearly as much inferior as superior range, and the mouth does not extend beyond their anterior angle. Lips equal.

Color in spirits light brown, the dorsal region blackish. A black spot in the middle of each lobe of the tail. Total length M. .125; length of head .019; to the base of anal fin .046; of anal fin .062. Width between bases of pectoral spines .016.

Two specimens from the collection of 1873.

21. **Cetopsis candira** Agass.

Coll. of 1877.

22. **Rhinodoras prionomus** Cope, Proceed. Academy Philada. September 1874, p. 134. *Rhinodoras teffeanus* Steindachner, Sitzungsberichte Akademie Wiss. Wien, 1875; read January, published ? Pl. III.

From Nauta, Coll. 1873.

23. **Rhinodoras niger** Valenc.

Coll. 1873. Nauta.

24. **Zathorax nauticus** Cope, Proceed. Acad. Phila. 1874, p. 133.

From Nauta.

In some specimens of this species the adipose dorsal fin is wanting, though generally present. The naked inferior surface of the scapular arch distinguishes this genus from *Doras*, and I now think that the peculiar form of the prefrontal bone has a similar value. The superior and anterior borders of the latter are free and pectinate as in *Physopyxis*.

The *Doras pectinifrons* m. presents the same character, but the scapular arch is covered below by thick skin as in *Doras*. I therefore regard it as representing a genus between the latter and *Zathorax*, which may be called *Agamyxis*. *Doras grypus* m. belongs to *Doras*.

25. HYPOPTOPOMA BILOBATUM Cope, Proceed Amer. Philos. Soc. 1870, p. 566.

Coll. of 1873.

26. HYPOPTOPOMA GULARE, sp. nov.

This species is more robust than the *H. bilobatum*, and differs in various respects. There are but 21 shields crossed by the middle line of the side instead of 25; the space between the sub-orbital bones and the clavicle is filled with an osseous shield wanting in *H. bilobatum*, and there is no median series of abdominal scuta. As compared with the *H. thoracatum* Günth, this fish exhibits similar proportions, having the head wider in proportion to the length than in *H. bilobatum*. But the scuta of the throat and thorax in *H. thoracatum* are as in *H. bilobatum*, as well as the number of scuta crossing the lateral line. The caudal fin has the lobes sub equal as in *H. bilobatum*.

Radii D. I. 7; A. I. 5; V. I. 5; P. I. 6. Pectoral spine reaching end of ventral spine; dorsal spine not branched at extremity, rather stout, nearly as long as the pectoral, its base 4 mm. nearer end of muzzle than base of caudal fin. Head very flat, quite wide, its width behind orbits about one-fourth the length to the base of the caudal fin; its length to the superior angle of the gill opening, 3.8 times into the same. The spine supporting the adipose fin, stands on the anterior border of the fourth dorsolateral scute counting from the base of the first superior caudal fulcrum. Some scuta between this point and the last dorsal ray. Each border of the muzzle supports a wide band of segments, within which a narrower band of segments bounds the median wedge-shaped area on each side. Inferior border of end of muzzle prickly; eye with some inferior range. Scuta of head above, and those below as far as vent, finely granular; the others smooth. Color olive brown, each scute of the body, and the three nuchal ones with a pale border within the edge. Caudal with the rays brown, except a wide margin, and a vertical line beyond base, which are pale. The dorsal fin is deep brown at the base, and has some dark spots on its middle. Length M. .105; to base of pectoral fin .028; to base of anal .052; elevation of dorsal spine .021.

Coll. of 1877.

27. CHÆNOTHORAX BICARINATUS. Gen. et sp. nov.

Char. Gen. Callichthyiform fishes with osseous dorsal and pectoral spines, a produced occipital shield, and 9–11 soft rays in the dorsal fin.

The coracoid shields are lateral, and do not cover the abdomino-thoracic region.

This genus is similar to *Gastrodermus* m. excepting in the increased number of dorsal radii, in which it is identical with *Brochis*. It might be called *Brochis* without coracoid breast shield. A synopsis of the species of this group is given below.

Char. Specif. Radii: D. I. 11; A. II. 6; V. 6; P. I. 7. The dorsal and pectoral spines are of sub-equal length and serrate behind only; their length equals the distance from the pupil of the eye to the end of the muzzle. The profile is rather steep; the head is compressed, and the muzzle is produced. The diameter of the eye is a little more than one-fourth the length of the head, is one-half the length of the muzzle, and half the interorbital space measured over the convexity. There are two azygous bones between the supra-occipital crest and the first dorsal spine. There are twenty three vertical scuta between the supra-temporal, and the base of the caudal fin; no dorsal or ventral azygous scuta. The postcoracoid plates are nearly smooth and sub-vertical, projecting downwards so as to form an obtuse keel on each side of the belly. Inferior bridge of scapular arch covered with soft skin. Maxillary beard nearly attaining gill fissure; inferior lip broadly reverted, produced into a short barbel on each side. Facial ossification extending one-third the distance to the maxillary; half way to the end of the muzzle, and not enclosing nares. Color olivaceous; top of head darker; fins immaculate. Length M. .059; of head .014; do. to base of ventral fin (axial) .022; to base of anal .035. Length of dorsal spine .011.

Coll. 1877.

A second species of this genus is the *C. semiscutatus* (*Corydoras* Cope, 1872). The species and genera of this group are the following:

Brochis Cope, Proc. Ac. Nat. Sci. Phila. 1871. Coracoid shields covering the breast; dorsal soft rays 9–11. The *Callichthys taiosh* Cast. probably belongs to this genus.

B. cœruleus Cope, loc. cit. 1872, p. 277.

B. dipterus Cope, loc. cit. 1872, p. 278.

Chænothorax Cope, supra. Coracoid shield not enclosing the breast and belly; dorsal soft rays 9–11.

C. bicarinatus Cope, supra.

C. semiscutatus Cope, Proceed. Acad. Phila. 1872, p. 280.

This species differs from the *C. bicarinatus* in the horizontally extended coracoid shields, the greater development of the facial ossification, the shorter muzzle, larger eye, and greater relative thickness of the head.

Corydoras Lacep. Bleeker; *Hoplisoma* Sws. Coracoid shields enclosing ventral region; dorsal soft rays 6–7.

C. punctatus Lac. Günther, Catal. v. 229.

C. æneus Gill. Günther, l. c.

C. eques Steind. Sitzungsberichte Wien Akademie, 1876 (July), p. 92, Pl. XII, fig. 3.

GASTRODERMUS Cope. Coracoids not enclosing the ventral region, which is covered with soft skin; dorsal soft rays 6–7.

G. ambiacus Cope, Proceed. Acad. Phila. 1872, 280.
G. trilineatus Cope, l. c. 281, Pl. VI, fig. 2.
G. acutus Cope, l. c. 281.
G. amphibelus Cope, l. c. 282.
G. armatus Günth. Proceed. Zool. Soc. Lond., 1868, 230, cut.
G. agassizii Steind. loc cit. sup. 90, Pl. XII, f. 2.
G. elegans Steind. l. c. 93.
G. nattereri Steind. l. c. 95, Pl. XI, f. 1.

28. GASTRODERMUS ARMATUS Gthr.
Coll. 1873.

29. GASTRODERMUS AMBIACUS Cope.
Coll. 1873. Nauta.

30. CALLICHTHYS ASPER Quoy. Gainn.
Coll. 1873. Nauta.

31. HOPLOSTERNUM LONGIFILIS Cuv. Val.
Coll. 1873. Nauta.

32. LORICARIA CATAPHRACTA L.
Coll. 1873. The Marañon.

33. LORICARIA ROSTRATA Spix.
Coll. 1873.

34. LIPOSARCUS JEANESIANUS Cope, Proceed. Acad. Phila., 1874, p. 135.
Coll. 1873. Nauta.

35. LIPOSARCUS SCROPHUS Cope, l. c. p. 136.
Coll. 1873. Nauta.

36. PLECOSTOMUS VIRESCENS Cope, l. c. 137.
Coll. 1873.

37. ARGES SABALO Cuv. Val.
Rio Urubamba; altitude 10,000 feet.

38. TRICHOMYCTERUS DISPAR Tsch. Cope, Proceed. Amer. Philos. Soc., 1877, p. 30.
Sources of the Ucayale at Urubamba, 10,000 feet, and Tinta, 11,400 feet.

39. TRICHOMYCTERUS GRACILIS (?) Cuv. Val., Cope, loc. cit. p. 30.
Tinta, 11,400 feet.

ASPREDINIDÆ.

40. BUNOCEPHALUS MELAS Cope, loc. cit. 1872, p. 132.
Coll. 1873. Nauta.

41. DYSICHTHYS CORACOIDEUS Cope, l. c. p. 133.
Coll. 1873. Nauta.

PLECTOSPONDYLI.

STERNOPYGIDÆ.

42. **CARAPUS FASCIATUS** Pallas.
Coll. 1873–1877.

43. **STERNARCHUS BONAPARTII** Castelnau.
Coll. 1877.

44. **STERNARCHUS ALBIFRONS** Linn.
Coll. 1877.

45. **STERNARCHUS SCHOTTI** Steindachner.
Coll. 1877.

46. **STERNARCHUS BALÆNOPS**, sp. nov.

Profile oblique, with a depression between the orbits; snout short, and much narrowed. Lower jaw large, projecting beyond the upper both anteriorly and laterally, enclosing the latter somewhat as in a whalebone whale. The fissure of the mouth is short, only reaching the vertical line from the anterior nostril. Eyes small, without free border, much nearer the snout than the gill opening, one-twelfth the length of the head, which latter enters the length without caudal fin, 8.5 times. The depth at the base of the dorsal thong is equal to the length of the head. Anal radii 171. Scales very large, in only nine longitudinal rows at the base of the dorsal thong. Color olivaceous, with a pale dorsal band which reaches the dorsal thong, and a pale narrow band on each side near the dorsal band. Length M. .165; length to origin of anal .020; length to base of dorsal thong .096.

This species resembles remotely the *S. schottii* of Steindachner, but differs from it and from all the other species in the much enlarged mandible and the large scales.

Coll. 1877.

47. **RHAMPHOSTERNARCHUS MACROSTOMA** Gthr., Catal. Brit. Mus. VIII, p. 4.
Coll. 1877.

48. **RHAMPHICHTHYS PANTHERINUS** Castelnau.
Coll. 1877.

49. **STERNOPYGUS VIRESCENS** Valenc.
Coll. 1873–1877.

50. **STERNOPYGUS TROSCHELII** Kaup.
Coll. 1877.

51 **STERNOPYGUS MACRURUS** Bl. Schn.
Coll. 1877.

CHARACINIDÆ.

52. **ANODUS MELANOPOGON**, sp. nov.

Char. Gen. Jaws edentulous; abdomen not serrate. Branchial fissures very extensive. Branchial arches furnished with long rakers, which are present on the fifth arch as well as the others.

This genus is *Curimatus* with a clupeiform branchial apparatus. In both the species the rakers on the anterior four arches are bristle-like, while those on the fifth resemble somewhat the pharyngeal teeth of *Catostomidæ*, although flexible.

This genus has never been distinguished from *Curimatus* until the present time. It is not unlikely that the second species included by Spix in *Anodus* (*An. latior*) is a *Curimatus*, but the *A. elongatus* must be regarded as the type of the genus. Cuvier established *Curimatus* on the *C. cyprinoides* (*Salmo edentulus* Bl. fide Gthr.) but included in it erroneously the *Anodus elongatus*, in which he is followed by Günther.

Since the above was written I learn that Professor Gill has described this genus under the name of *Elopomorphus*, in a recent number of a popular journal.

Char. Specif. General form slender, head elongate, and with acuminate muzzle, with the mandible projecting, beyond the premaxillary border. Length of head entering total without caudal fin, three and two-thirds times; depth of body at dorsal fin, less than one-sixth of the same. Eye large, one sixth of length of head entering one and one-fourth times into length of muzzle and interorbital space, which are thus equal. Opercular bone as long as deep; interoperculum large; extremity of maxillary extending a little beyond vertical line from anterior rim of orbit.

Radii; D. 1 10; A. I. 10; V. 11; P. 19. Base of first dorsal ray 3 mm. nearer end of muzzle than base of dorsal fin, pectoral fin reaching half way to ventrals, and ventrals half way to anal. The scales are small, in about 128 transverse rows, and at the origin of the anal fin in 23 longitudinal rows. The origin of the ventrals is below the middle of the dorsal fin. Total length M. .075.

Color blackish above and one-third way down the side; sides and abdomen, with sides of head silvery. Dorsal and caudal fins dusky and without spots. End of mandible black.

Coll. of 1873; numerous specimens.

53. Anodus steatops, sp. nov.

While the preceding species has rather clupeiform character, the present one looks like a *Hemiodus*, and particularly the *H. microlepis*, with which it was found associated in the collection. It differs much from the *H. melanopogon* in the even lips, and the extensive adipose membrane which closes the eye to an even greater degree than is found in the *H. microlepis*, reducing it to a vertical fissure. Radial formula D. I. 10; C. 3 + 19 + 3; A. I. 11; V. 12; P. 19, reaching half way to ventrals; ventrals reaching half way to vent. The ventrals originate below the middle of the dorsal fin, which originates exactly half way between the end of the muzzle, and the base of the superior caudal fulcra. Scales small, $\dfrac{13\text{–}14}{\dfrac{93}{10}}$. The general form is slender, the depth entering the length less the caudal fin 5.3 times; and the length of the head entering the same 3.6 times. The diameter of the eye as seen through its adipose covering is a little less than one-fifth the length of the head; and is one-half the interorbital width measured over the strong convexity of the frontal bone. The maxillary bone makes an angle with the premaxillary, and extends as far as the line of the anterior border of the orbit; the greater part of its length passes beneath the edge of the preorbital bone. The opercular apparatus is elongate, but the operculum is deeper than long. Total length M. .205; length of head .047; length to origin of dorsal fin (axial) .082; do. of ventral .090; do. of anal fin .134.

Color in spirits steel blue, paler below; base of the caudal fin extensively black; other fins unspotted. Sides of head golden; chin and top of head black; a golden speculum above the orbit.

Coll. of 1877.

54. CURIMATUS ALTAMAZONICUS, sp. nov.

This is a robust species with small scales. The form is elongate-oval, and the head wide. The pectoral region is not flattened nor covered with roughened scales, while the ventral line from the ventral fins to the vent is keeled, but not serrate. The dorsal fin is elevated, its anterior rays being four-fifths as long as the head.

Radii; D. I. 10; A. I. 12; V. 9; P. 13. The pectorals do not reach the ventrals, nor the latter the vent. The ventrals originate below the fifth dorsal spine. First dorsal ray much nearer the end of the muzzle than the base of the caudal fin. Scales 25–94–22. Depth at first dorsal ray entering length minus caudal fin 2.7 times. Length of head in the same three and two-fifth times. The eye enters the length of the head four and four-fifth times, and twice in the moderately convex interorbital width. Lips equal, the inferior closing within the superior. Maxillary bone short, not extending behind the line of the nares. Color silvery without spots on the body or fins. Total length M. .200; length of head .049; do. to origin of dorsal fin (axial) .070; do. to origin of ventrals .080; to origin of anal fin .124.

This species appears to be nearest the *C. latior* Spix. judging from descriptions. In that fish the anal rays are said to be 14–15, and the dorsals 12.

Coll. 1873.

55. CURIMATUS SPILURUS, Günth. Steind.

Coll. 1873.

56. CURIMATUS TRACHYSTETHUS, sp. nov.

This is a moderately elongate species with the preventral region flattened, and covered with large, thick striate and dentate scales; and with the postventral region also flattened, and without distinct median keel. Radial formula D. I. 10; C. 2 + 19 + 2; A. I. 8; V. 9; P. 16. The pectorals nearly reach the ventrals, which originate below the middle of the dorsal fin, and reach to the vent. The anal fin has a short basis which is equal to its distance from the vent; folded backwards it reaches the base of the caudal fin. The elevation of the dorsal fin exceeds the length of the head. The depth at the front of the dorsal fin is one-third the length of the caudal; the length of the head is one-fourth the same.

The eye is large, entering the length of the head 3.25 times and the flat interorbital space 1.5 times. The muzzle is flat and projects a little beyond the lower lip. The mouth does not extend to the line of the orbit. The inferior suborbital bone is much longer than the others. Total length M. .128; length of head .026; to base of dorsal .040; of ventral .047; of anal .080. Scales 8–48–6.

Color silver, with bluish reflections above; a bright line along the middle of each row of scales. Fins immaculate except a round spot on the dorsal fin below its middle.

This species is allied to the *C. asper* of Günther, but that fish has smaller scales, more anal rays and other characters. (See Proceed. Zool. Soc. Lon., 1868.)

Coll, of 1877.

57. POTAMORHINA PRISTIGASTER: *Curimatus pristigaster* Steindachner, Sitzungsberichte Akad. Wiss. Wien, 1876, July (separata p. 25), Pl. VI.

This species, well described and figured by my friend Dr. Steindachner, is too distinct from the species of *Curimatus* to remain in that genus, in my opinion. It presents between the ventral and anal fins not only a keel, as in many species of the genus named, but the keel is surmounted by a series of acute recurved spiniform scales, quite unlike the normally formed ones which bound it in the keeled species of *Curimatus*. I therefore propose for it the generic name above written. The spinous processes are stronger in my specimens than in the figure given by Dr. Steindachner.

Coll. 1873.

58. PROCHILODUS ORTONIANUS, sp. nov.

Radial formula D. I. 10; C. 3–19–2; A. III. 8; V. 9; P. 14. Scales 9-44–7. Depth of body at dorsal fin entering the length less the caudal fin $3\frac{2}{11}$ times; Length of head entering the same 3.7 times. Diameter of eye entering head 4.5 times, or one and a half times in the muzzle and two and a half times in the interorbital width. From these figures it is evident that this is a moderately elongate species, with rather elongate and wide head. The frontal region is convex, and the upper lip does not project beyond the lower as in *P. harttii* Steind. The pectoral fins reach the ventrals, but the latter fall far short of the anus. The belly between the latter and the base of the ventral is keeled, but not serrate. The dorsal fin is situated a little in advance of the ventrals, and is quite elevated, equaling the length of the head. Caudal fin rather short and robust. Total length M. .200; length of head .046; do. to base of dorsal (axial) .072; do. to ventral (axial) .083; to base of anal .134; depth of caudal peduncle .020.

Color silvery, above shaded with blackish; the scales at the base of the anal fin inserted in a blackish skin. Dorsal fin with six or seven cross-rows of blackish dots, which only mark the rays. Caudal fin with four cross-bands of rather obscure character, which follow the posterior contour of the fin, except the posterior, which cross the apices. A large specimen, measuring M. .350, is uniform silvery everywhere.

From Nauta, Peru, coll. 1873.

This species is dedicated to the memory of my late friend, Prof. James Orton, as a slight expression of my respect for him as a man, and of my admiration for his fearlessness and energy as an explorer.

59. PROCHILODUS CEPHALOTES, sp. nov.

There are several points of affinity to the *P. argenteus* to be observed in the small specimen referred to this species. Radii D. I. 10; A. II. 10; scales 10–? 41–? depth entering length without caudal fin 2.7 times; length of head three times. The head is wide, the interorbital width being half the length, and nearly twice the diameter of the eye. The latter is rather less than the length of the muzzle. The pectoral fins are small, not reaching the ventrals, which in turn do not reach the vent. Dorsal fin with three or four transverse rows of brown spots. General color plumbous; above blackish.

Total length .071; length of head .021; to dorsal fin (axial) .024; to ventral fin .029; to anal fin .045.

The much larger head and the spotted fins distinguish this fish from the *P. argenteus*, which it resembles in scale and fin formula, and depth of body.

Coll. of 1873.

60. EMIODUS MICROLEPIS Kner.

Coll. 1873–1877.

61. RŒBOIDES MYERSII Gill, Proceed. Acad. Phila. 1870, p. 92.

Radii; D. I. 10; A. I. 48; scales 24—80+5—23. Head entering total length less caudal fin, 2.33 times, and head entering the same, 3.6 times.

Coll. of 1877.

62. ANACYRTUS SANGUINEUS Cope, Proceed. Acad. Phila. 1872, 266, Pl. 9, fig. 1.

Coll. 1873.

63. ANACRYTUS LIMÆSQUAMIS, sp. nov.

A species of robust proportions, distinguished by its small rough scales. The body is rather deep, and the head wide with very convex interorbital region. The depth enters the length less the caudal fin 2.8 times, and the head enters the same 3.7 times. The eye enters the head five times, and the interorbital region over its convexity 2.5 times. Scales 27–112–28; the exposed surfaces covered with minute prickles. Radii D. I. 10; A. I. 41; V. 7; P. 16, reaching beyond the base of the ventrals, which nearly reach the vent. The first anal ray commences below the seventh dorsal ray.

The top of the head is concave in profile, and the jaws are equal. There are two rows of premaxillary teeth, of which the inner consists of very few teeth. One series of mandibular teeth including three canines, of which the middle one is the largest. Two canines in the premaxillary bone, the anterior much the larger. Maxillary teeth numerous. Maxillary bone extending considerably beyond the posterior border of the orbit. Opercular bones narrow.

Color gray, with a broad golden lateral band above the lateral line. In the anterior part of the latter is a large black spot which is situated nearer the opercular fissure than the line of the first dorsal ray. An indistinct black spot at the base of the caudal fin. Total length M. .220.; of head .025 ; to base of ventral fin (axial) .075 ; do. of dorsal fin (axial) .088 ; do. to origin of anal .115.

Coll. 1877.

64. XIPHORHAMPHUS ABBREVIATUS, sp. nov.

Form stout and robust, the depth of the ventral fin entering the length minus the caudal fin three and a half times. Length of head entering the same about three times. The muzzle is relatively short, being only one and a half times the length of the long orbit. This enters the head 4.75 times, and the flat interorbital space 1.5 times, which therefore equals the length of the muzzle. There are two distant large canines on the anterior part of the maxillary bone and four smaller ones ; the maxillary teeth are minute. There are two distant canines on the premaxillary, and four large ones on the dentary, with a terminal tooth of small size. The maxillary is covered for its entire length by the preorbital, and extends to a half orbits diameter behind the posterior border of the orbit.

Radial formula D. I. 10 ; A. II. 21 ; V. 8 ; P. 16, reaching base of ventrals, which reach vent. Dorsal fin elevated, equaling length of head without muzzle, originating behind line of ventrals, and terminating just in front of line of first anal ray. Scales 25–90 + 3–10, smooth, those of the lateral line not longer than the others. Breast below shoulder girdle, keeled.

Color silvery bluish, with a wide paler shade along the side ; a black humeral and basal caudal spot. Fins immaculate, pectorals and ventrals dusky. Total length M. .212 ; of head .038 ; to origin of ventrals (axial) .090 ; do of dorsal .109 ; do. of anal .130.

Coll. 1873–1877.

65. XIPHORHAMPHUS HETEROLEPIS, sp. nov.

An elongate species in which the depth enters the length with the caudal fin six times, and the head enters the same three and six-tenth times, or three and three-tenth times without the caudal fin. The muzzle is narrowed and convex above, and is not so long as from the anterior border of the orbit to the preopercular border. The dorsal fin is in the posterior part of the second third of the length (without caudal fin). Formula ; D. I. 10 ; A. II. 25 ; V. 8 ; P. 15, reaching more than half way to ventrals, which extend half way to vent. Scales very small, those of the lateral line larger than the others, and crossed by a vertical ridge beyond their middle : formula 38—121+8—23.

The diameter of the bony orbit enters the head 5 times, and the interorbital space 1.25 times. The front and ethmoid region exhibit a few longitudinal ridges, and there is no rugosity on the epiotics. There are two foramina for the accommodation of two inferior canine teeth on each side. Total length M. .360. The first suborbital bone behind the preorbital, is narrow. Color silvery, on the side golden ; a basal caudal, no humeral spot.

Several specimens : colls. of 1873–77.

This species appears to be allied to the *X. falcatus*, from Guiana, as defined by Günther, but this author does not allude to some of its prominent characters. According to his description, that is a stouter species having the depth one-fifth the length, and the head smaller, or one-fourth the same. It has also a humeral spot. All my specimens have 25 anal rays, not 28–30 as given by Dr. Günther.

66. XIPHORHAMPHUS FALCIROSTRIS Cuv., Günther.

This species, of which I have two specimens, differs from the last as follows: Anal radii (soft) only 21; dorsal fin in the posterior third of the length minus caudal fin; scales equal, 36—151+8—15. Head and muzzle wider, the latter without ridges above, and with only one foramen for the inferior canines. First suborbital bone wider. It differs from Günther's description in having the muzzle considerably shorter than the distance from the anterior border of the orbit to the preopercular border. I add that the supraoccipital crest is short, and the epiotic region rugose. Depth one-sixth length without caudal fin; length of head in same 3.7 in the same. There is a caudal but no humeral spot. Total length M. .285.

Coll. 1873–77.

67. HYDROLYCUS PECTORALIS Günther, Ann. Magaz. Nat. Hist., 1866.

Coll. 1873–77. Nauta.

68. RAPHIODON VULPINUS Spix., Agass.

Coll. 1873–77.

69. RAPHIODON GIBBUS Spix., A. 75.

Coll. 1873.

70. XIPHOSTOMA TÆDO Cope, Proceed. Acad. Philada., 1872, p. 267, Pl. XIII, fig. 2.

Specimens of this species in better preservation than the types, show that the belly is black, and that there is a large black spot on the inferior side of the caudal peduncle at the base of the caudal fin. They also show that all but the anterior portion of the lateral line is wanting. These characters indicate that this is a distinct species from the *X. maculutum* with which it is united by Steindachner. At least they are not found in author's figures and descriptions of the latter.

71. CHARACIDIUM STEINDACHNERI, sp. nov.

This, the third species of the genus, is of more slender form than either of the two known hitherto, and has a smaller number of longitudinal rows of scales. The number of transverse rows is as in *C. fasciatum* the type, and larger than in *C. etheostoma*. The fin rays are less numerous than in *C. fasciatum*.

Radii; D. 9: A. 7; V. 9; the first ray a little behind the origin of the dorsal fin, and the produced apex of the fin nearly reaching the anal. The pectoral fin is also prolonged, attaining the base of the ventral. The length of the head is greater than the depth of the body entering the length less the caudal fin, 4.33 times. The greatest depth enters the same 6.5 times. Scales 4–37—2 or 1½; 5½ rows on the stout caudal peduncle. Lateral line complete.

The muzzle is acuminate and the mouth very small. The orbit is large, its diameter exceeding the muzzle, and entering the head four times, and exceeds the interorbital width by nearly its half.

The color is plain, with the row of scales bearing the lateral line silvery and without dark borders. There are nine narrow rather weak vertical blackish bars, between the caudal fin and the occiput. Inferior fins unspotted; caudal with a dark shade at the base, and one at the extremity. Total length M. .029; of head, .006; to line of dorsal fin .010; to do. of anal, .018; to basis of caudal .026.

This species is dedicated to my friend Doctor Franz Steindachner, of Vienna, the distinguished zoölogist, who has added much to our knowledge of the fishes of the Amazon. I have derived much instruction in this department from his very full diagnostic analyses.

Coll. of 1873.

72. APHYOCHARAX PUSILLUS Günth.

Coll. 1873.

73. SCHIZODON FASCIATUS Spix.

Coll. of 1877.

74. SCHIZODON SAGITTARIUS, sp. nov.

This species is more elongate and slender than any of the known representatives of the genus; the vertical diameters of both head and body being reduced. The extension of length is in the post dorsal region. Length of head into the total, less the caudal fin, a little more than five times; depth of body into the same nearly six times, hence less than length of head. Radii, D. I. 11; C. 2 + 19 + 2; A. I. 9; V. 9; P. 16. Dorsal fin originating anterior to the point marking two-fifths the distance from the end of the muzzle, to the base of the caudal fin; its elevation equal to the length of the head. Pectoral fin not reaching the ventral, which does not reach half way to the vent, and originates below the fourth dorsal ray. Orbit entering the length of the head 4.2 times, and the interorbital width twice; the inferior range of vision is a little greater than the superior. Mouth terminal, the mandible a little longer than the premaxillary, and armed with six teeth. These are smooth externally, and have two principal cusps. The superior are denticulate, the denticles arranged into three cuspidate groups. In both jaws the median teeth are larger than the lateral. Total length, M. .165; length of head .027; length to origin of the dorsal fin .051; do. to origin of ventrals .057; do. line of origin of anal fin .110. Above dusky to second row of scales below the lateral line; below this point silvery. Fins unspotted except the caudal, which has a dark longitudinal shade along the middle of each lobe.

This species is probably allied to the *Rhytidodus argenteofuscus* of Kner, but in that species according to Kuer, the superior teeth have but one point, those of both jaws are keeled externally, and the depth of the body exceeds a little the length of the head. The inferior tooth figured by Kner is entirely unlike those of this fish.

Coll. 1877.

75. **Schizodon trimaculatus** Kner.
Coll. 1877.

76. **Leporinus vittatus** Cuv. Val.
Coll. 1877.

77. **Leporinus frederici** Bloch.
Coll. 1877.

78. **Leporinus hypselonotus** Günth. Proceed. Zool. Soc. London, 1868, p. 244.
Coll. 1877.

79. **Leporinus holostictus**, sp. nov.

This handsome species is distinguished by the continuation of the very distinct brown cross bands on to the head, the first one covering the end of the muzzle. The depth of the body is about equal to the length of the head, entering the length less the caudal fin four and a quarter times. The orbit is large, its diameter entering the length of the head four times, and the interorbital width one and five-sixth times. Scales 6–41–5. Radii D. I. 11; A. I. 9; V. 10; P. 14, reaching half way to ventrals, which originate below the fourth dorsal ray. There are eight teeth in each jaw; those of the mandible are small, excepting the median pair, which are much prolonged, and acute. The color is silvery, darker shaded above, crossed by seven black cross bars on the body, one additional on the nape, and two on the head. Those on the head are on the muzzle, and between the orbits; the five behind the ventral fins pass entirely round the body. There is in addition a dusky shade at the emargination of the dorsal fin. Fins otherwise unspotted. Length M. .107; of head .026; to line of dorsal fin .049; to base of anal .082; to base of caudal .104.

Coll. 1877.

80. **Leporinus multifasciatus**, sp. nov.

Depth of body and length of head sub-equal, and entering the length less the caudal fin 3.66 times. The eye is large, its diameter being a little less than one-third the length of the head, and five-eighths of the interorbital diameter. The length of the muzzle is five-sixths the length of the head posterior to the orbit. Scales 4–36–5. Radii; D. I. 11; A. I. 10. Ventral fin below the fourth dorsal ray; pectoral reaching half way to ventral.

Color brown, with fourteen vertical darker brown bands, the first at the nape, the last near the base of the caudal fin, with its middle interrupted, the interruption being followed by a dark spot. Fins unspotted. Total length M. .065; of head .015; to line of dorsal fin .024; of anal .044: to basis of caudal .055.

No other species presents the numerous cross bands of this one.

81. **Hemigrammus robustulus** Cope, Proceed. Amer. Philos. Soc. 1870, p. 561.
Coll. 1873.

82. **Tetragonopterus hauxwellianus** Cope, Proceed. Amer. Philos. Soc. 1870, p. 560.
Coll. 1873.

83. **Tetragonopterus chalceus** Agass.
Coll. 1877, from the Marañon.

84. **Tetragonopterus ortonii** Gill. Proceed. Acad, Phila. 1870, p. 92.
Coll. 1873.

85. **Tetragonopterus agassizii** Steindachner, Sitzungsber., K. K. Akad. Wiss. Wien, 1876 (July) 41, Pl. VIII, fig. 2.

Two specimens from near Pebas resemble the species above named in all points excepting in the more elongate body, so that I suspect them to represent a local race. There are 1.24 anal radii, and the longitudinal rows of scales are 5—1+3–4. The total length without caudal fin is M. .034; depth .013; length of head .0105. The caudal spot is very large, covering the basal half of the fin, while the humeral spot is obsolete.

86. **Tetragonopterus longior**, sp. nov.

One of the more elongate forms of the genus. Radii D. I. 10; A. I. 24. Longitudinal series of scales twelve. The greatest depth enters the length less the caudal fin 4.7 times, and the length of the head the same 4.2 times. The diameter of the orbit enters the length of the head 3.5 times, and the interorbital width 1.33 times. The maxillary bone is toothless, and rather wide, and extends little beyond the line of the anterior border of the orbit. The origin of the dorsal fin is behind the line of that of the ventrals, and is nearer the origin of the caudal fin than the end of the muzzle by the length of the latter.

There is a broad silvery lateral stripe, on which is a strong black humeral spot. There is no distinct basal caudal spot. Total length .095.

Coll. of 1874, from Moyabamba.

87. **Tetragonopterus**, sp. indet.
Coll. of 1873.

88. **Tetragonopterus**, sp. indet.
Coll. of 1873.

89. **Tetragonopterus diaphanus**, sp. nov.

An elongate species distinguished by the small number of its anal rays. D. I. 9; A. I. 18; V. 7, originating a little anterior to line of dorsal, and not reaching anal: P. 13, not reaching ventrals. Dorsal fin nearly equi-distant between end of muzzle and base of caudal fin. Anterior rays of dorsal and anal fins markedly longer than the posterior. Depth entering length less caudal fin three and one-seventh times; length of head into the same, four and two-fifth times. Scales 4–35–3.5; lateral line complete. Maxillary bone toothless, extending near to the line of the anterior border of the orbit. The latter enters the length of the head 2 and 3–4th times, equaling the interorbital space.

Total length M. .052; of head .011; to line of ventral fin .020; to line of anal .028. Color silvery, with a broad bright silver lateral band, and no bright spots.

Coll. 1874.

90. TETRAGONOPTERUS IPANQUIANUS Cope, Proceed. Amer. Philos. Soc. 1877, p. 28. Urubamba River; elevation 11,500 feet.

Coll. of 1877.

91. STETHAPRION CHRYSEUM Cope, Proceed. Academy, Phila. 1872, p. 261.

Coll. 1877.

92. CHALCINUS CULTER Cope, l. c. 265.

Coll. 1873.

93. TRIPORTHEUS NEMATURUS Kner.

Coll. 1873.

94. SERRASALIMO IMMACULATUS sp. nov.

This species belongs to the restricted genus *Serrasalmo*. There are six premaxillary teeth, of which the third is much smaller than the others. Each tooth has a denticle at its posterior base, which in the case of the external tooth is longer horizontally than the principal cusp, and is not apiculate. There are seven in the lower jaw, of sub-equal size, each with a posterior basal denticle, except the anterior, which has two basal denticles.

The form is discoid, the depth entering the length less the caudal fin 1.8 times, and the length of the head entering the same three times. The dorsal and ventral outlines are equally convex, but the steeper slopes are opposite the anterior above, and the posterior below. Scales small 34–100–33. Radii; D. 17; A. I. 32; V. 7, not reaching vent; P. 15, reaching base of ventrals. Spines 33–4. Gill rakers of first arch short, and with short apices. Diameter of eye entering length of head (including chin) five times; and nearly twice in the interorbital space measured over its convexity. The origin of the dorsal fin is above the ventral, and equi-distant between the base of the superior marginal ray of the caudal fin and the posterior border of the orbit. The superior caudal rays are not so long as the inferior. Second sub-orbital bone as high as long. Muzzle a little longer than diameter of orbit. The color is silvery without distinct spots; in certain lights numerous small lead-colored spots may be detected on the dorsal region, extending half way down to the lateral line. Caudal and anal fin broadly black bordered; no yellow band. Total length M. .190; of head 055; to line of dorsal fin .090; to line of anal .116; to basis of marginal caudal rays .161.

This species is near the *S. æsopus* Cope, but is readily distinguished by the much more numerous scales, and the longer muzzle.

Coll. of 1877.

95. METYNNIS LUNA, gen. et. sp. nov.

Char. Gen. This is *Myletes* with an external horizontal cultriform spine at the base of the dorsal fin as in *Serrasalmo* and *Stethaprion*. The premaxillary teeth are in two series, and have an oblique, more or less in conspicuous cutting edge, as in *Myletes*. Two conical teeth behind the mandibular series. The belly is armed with spiniferous ? interhæmal bones.

This form is related to *Myletes* precisely as *Stethaprion* is to *Tetragonopterus*. But one species is known to me.

Char. Specif. Form orbicular, the dorsal region very convex; the abdominal outline still more so. The depth is eleven-twelfths of the length less the caudal fin, and the length of the head enters the latter three and two-tenth times. The depth of the head from the superior border of the post-temporal bone equals the length. The eye is large, entering the length of the head three and one-sixth times, and the convex interorbital space one and one-half times. The chin projects a little beyond the premaxillary border, and the end of the toothless maxillary bone is immediately below the proximal extremity and below the nostrils.

Radii; D. I. 17; A. 39; V. 7; P. 14. The ventral fins are very small, and their base is contracted, so that the spines are arranged nearly in a circle, the inner and outer being of equal length. The pectorals are small, marking only the third of the distance to the line of the ventrals. The base of the anal makes an angle of only 25° with the vertical; its anterior rays are little prolonged. The base of the dorsal is oblique downwards and backwards, and the first ray marks a point at .4, the distance between the bases of the pectoral and ventral fins. The length of the base of the adipose dorsal is two thirds that of the rayed dorsal. Ventral spines 25, the anterior recurved and simple, the posterior more or less bifurcate. The head of the predorsal spine is anvil-shaped. The suborbital bones are narrow; the anterior is the widest, and is triangular with the long apex superior.

Scales between the lateral line and the ventral fins, 39–40, those of the lateral line (in front) larger than the others. Total length, M. .075; of head, .020; to line of ventral fin, .033; of anal, .046; of caudal fin, 060. First dorsal ray equidistant between base of caudal marginal ray and end of muzzle, measured in straight lines. Color golden, excepting the superior half of the region above the lateral line, which is dove-color in spirits. No spots of any kind.

Coll. of 1877.

96. MYLETES HERNIARIUS Cope, Proceed. Acad. Phila. 1872, p. 268.
Coll. of 1873.

The specimen here recorded differs slightly from the type in some details. Dorsal radii in both, 17; anal in type, 32; in new specimen, 35; spines in type 46; in new specimen 51. There is a faint eye-like spot on the side in the new specimen, not seen in the type, and some indistinct vertical shades.

Coll. of 1873.

97. **MYLETES NIGRIPINNIS**, sp. nov.

Premaxillary teeth in two series, which are in close contact. The anterior series is curved, and consists of ten teeth with a space as wide as a tooth in the centre; the posterior series is uninterrupted, and consists of four teeth. The mandibular series is uninterrupted, and consists of seven teeth on each side, the posterior four being much smaller than the others. The two posterior mandibulars are in contact with the median pair of the anterior series, and are separated by a narrow interspace from each other.

The general form is broadly rhombic. The depth is one-half the length with the caudal fin, and the length of the head enters the same three and one-half times. Radii; D. I. 15; A. 23; V. 8; P. 16. The inferior paired fins are very short; the others are well developed. The adipose fin is furnished in its superior part with *jointed rays,* the inferior portion is scaly. The base of the anal fin is covered with minute scales. The origin of the first dorsal ray is a little behind that of the ventral fin, and the anal begins under the last third of the former. Ventral spines 46, all simple and recurved. Scales 26—65+6—21; the lateral line considerably decurved behind the head. The head is wide and depressed above the orbits. The latter enter the length of the head 4.5 times; the inter-orbital space 2.5 times, and the muzzle once, axially measured. The frontal region is moderately convex in cross section. The mandibular teeth close within the premaxillaries, and the upper jaw projects beyond the mandible. The lips are equal, however, in consequence of the thickness of the lower, which fills the space. Its superior surface is pappillose, and at the points where it comes in contact with the maxillaries it is continued as a free beard on each side, reaching to below the centre of the nares when extended. The maxillary is folded under the preorbital, but its posterior border cannot reach the line of the anterior border of the orbit.

Total length. M. .130; of head, .040; to line of dorsal fin, .055; to line of anal, .079; to base of caudal fin, .103. Color silvery, plumbeous above; the sides marked with rather large round plumbeous spots. A silver band on each side of the ventral spines. Anal fin, caudal, except superior and inferior border, and terminal halves of paired fins, black. Dorsal dusky.

In a larger specimen, probably from Nauta (230 mm.), the scales are finely ctenoid, those at the bases of the median fins coarsely so. The head is furnished with minute rugosities, and there are no labial beards nor color spots.

Coll. 1873–1877.

98. **Myletes bidens** Spix.
Coll. 1873.

99. **Macrodon trahira** Spix.
Coll. 1873-77.

100. **Erythrinus salmoneus** Gron.
Coll. 1873–77.

101. **Erythrinus brevicauda** Gthr.
Coll. 1873.

102. **Pyrrhulina argyrops**, sp. nov.

Radii; D. I. 9; A. I. 9. Scales in seven longitudinal, and about twenty-five transverse series. The scales are lost from the anterior part of the body in two specimens, so that the number given is not absolutely certain, but very probable. Origin of dorsal fin immediately above that of ventral, and exactly half way between the base of the superior marginal ray of the caudal fin and the anterior border of the orbit. Pectorals not reaching the rather large ventrals, which fall considerably short of the anal. Head in total length less caudal fin, four and one-sixth times, and equal depth of body at dorsal fin. Eye large, its diameter entering length of head three times, exceeding muzzle by nearly half, and entering interorbital space 1–5 times. Suborbital bones reaching pre- and interoperculum. The mandible projects, and the maxillaries are very short and subdiscoid, closing into an external concavity at the base of each ramus. Color olivaceous, except a silver spot at the center of each scale. Fins unspotted, except the dorsal, which has a large black spot over its middle portion, no black band on head, which is silvery on the sides.

Coll. 1877.

ISOSPONDYLI.

OSTEOGLOSSIDÆ.

103. OSTEOGLOSSUM BICIRRHOSUM Vand.

Coll. 1873.

104. ARAPÆMA GIGAS Cuv.

Probably Nauta, 1873.

HAPLOMI.

CYPRINODONTIDÆ

105. RIVULUS MICROPUS Stein., Gthr.

Coll. 1873.

SYNENTOGNATHI.

BELONIDÆ.

The genus *Belone* must be placed in a family group distinct from that which includes the genus *Exocœtus* and its allies. I have already pointed out the fact that it possesses a distinct coronoid bone; in addition to this, the vertebræ display zygapophyses, a character unusual among fishes. On these two characters I propose the family *Belonidæ*. Professor Gill has already created this name, but he did not define the group to which he applied it.

106. BELONE TÆNIATA Günther.

Coll. 1873–77.

PLECTOGNATHI.

TETRODONTIDÆ.

107. TETRODON PSITTACUS Bl. Schn.

Coll. 1873.

PERCOMORPHI.

CHROMIDIDÆ.

108. HEROS AUTOCHTHON Gthr.

This species is stated by Dr. Steindachner to be confined to the coast rivers of Brazil, and not to occur in the valley of the Amazon. I cannot distinguish my Peruvian specimens from the descriptions furnished by him and by Dr. Günther.

Coll. 1877.

109. HEROS BIMACULATUS Linn. Cope; *Acara* Gthr.

Coll. 1873–77.

110. ACARA FLAVILABRIS Cope, Proceed. Amer. Philos. Soc, 1870, p. 570. Proceed. Acad. Phila. 1872, Pl. XI, fig. 4.

Dr. Steindachner in the Sitzungsberichte of the Vienna Academy for 1875, p. 6 (*separata*), expresses the opinion that this species is the *A. tetramerus* Heck., basing it on a presumed error on my part in the counting of the scales on the cheek. He finds my figure above cited to disagree with my last description, in possession of three rows of cheek scales while I have stated that only two exist. An examination of numerous specimens additional to those already in my possession, shows that they only exhibit two rows of cheek scales as I have described. Dr. Steindachner has evidently misunderstood my figure, for there are but two rows of cheek scales represented on it as described. The third row belongs to the inferior limb of the peroperculum. The figure only is defective in the dark shading of the inferior lip, which is yellow in life.

Coll. 1873.

111. ACARA SYSPILUS Cope, Proceed. Ac. Phila. 1872, p. 255, Pl. XI, fig. 3.

In a larger specimen of this species than the type, the body is relatively deeper, and the eye a little smaller, and the vertical bands are less decided.

Coll. 1877.

112. ACARA SUBOCULARIS, sp. nov.

Radii D. XIII, 11; A. III, 8; V. I. 5, nearly reaching vent, and originating below the fourth dorsal spine Scales 3—30–2—8–9; on cheek five rows. Form rather elongate; head not robust, its length entering the total less the caudal fin 3.4 times. The depth at the ventral fin enters the same 2.75 times. The preorbital bone is as wide antero-posteriorly as the orbit, and exceed the interorbital space by 1 mm. The orbit is thus behind the middle of the head, into whose length it enters 3.6 times. Its superior rim is in the frontal plane. The fourth and longest dorsal spine is as long as the cranium from the superior extremity of the branchial fissure to the anterior border of the orbit. The profile descends from the supra-occipital crest in a nearly straight line, with a slight concavity at the front of the orbit.

Color light brown, with a narrow vertical black spot just below the lateral line opposite the middle of the ventral fin. A black spot on the upper anterior portion of the spinous dorsal fin. A vertical black band from the eye to the inferior edge of the preoperculum.

Total length M. .075; of head .017; to basis of ventrals (axial) .022; to basis of anal .039; of caudal .058; depth .021.

This species resembles the *Geophagus cupido*.

Coll. of 1877.

113. **Acara hyposticta**, sp. nov.

Radii; D. XIII 19; A III 15⅓. Scales 6—30–3—17–8; six rows on cheek. The ventral fins commence under the third dorsal spine. The longest (fourth) dorsal spine is equal to the diameter of the bony orbit, which nearly equals the flat interorbital space. The preorbital bone is as long antero-posteriorly as one-third the diameter of the orbit, which is one-third the length of the head, exceeding a little the length of the muzzle. The extremity of the maxillary bone extends a little beyond the line of the anterior border of the orbit.

The form is a moderately wide oval, with the profile from the base of the dorsal fin a perfectly straight line to the end of the muzzle. The depth at the ventral fins enters the length less the caudal 2.1 times, and the length of the head enters the same 2.6 times. Total length M. .095; of head, .027; to origin ventrals, .031; of anal, .049; of caudal, .070.

The single specimen in my possession is in rather bad condition. It is of a light brown color, the dorsal, caudal and anal fins with brown spots. The ventrals are cross-banded with deep brown; and anterior to them, five similar bands, separated by silvery interspaces, cross the inferior surface, the anterior three of which rise to the superior border of the inferior ramus of the preoperculum. A brown horizontal line extends posteriorly from the mouth.

The soft radii of the median fins are more numerous in this than in any of the described species. This character, with the peculiar coloration, will distinguish it from all of them.

Coll. of 1873.

114. **Acara ocellata** Agass. (Steind.) *Hygrogonus* Gthr.

Coll. 1877.

115. **Geophagus cupido** Heck.

116. **Geophagus tæniatus** Gthr.

Two specimens: one of which exhibits a deep brown band along the middle line of the abdomen, which is wanting in the other.

A third species from Pebas, the *Geophagus badiipinnis* Cope, is thought by Dr. Steindachner to be a *Chætobranchus*. It has, however, the branchial structure of the genus to which I referred it.

117. **Cichla ocellaris** Bl.

Probably Nauta 1873.

118. **Crenicichla proteus** Cope, Proceed. Acad., Phila. 1872, p. 252.

Coll. 1877.

119. **Crenicichla lucius** Cope, Proceed. Amer. Philos. Soc., 1870, p. 570.

Coll. 1873. From the Cachyiacu, an affluent of the Huallaga, near Moyabamba.

120. **Crenicichla joanna** Heck.

Coll. 1877.

GENERAL OBSERVATION.

The 121 species enumerated in the preceding pages are distributed among the following natural families.

Symbranchidæ	1
Hypophthalmidæ	2
Siluridæ	36
Aspredinidæ	2
Sternopygidæ	10
Characinidæ	52
Osteoglossidæ	2
Cyprinodontidæ	1
Belonidæ	1
Tetrodontidæ	1
Chromididæ	13
	121

The preceding families have all been known heretofore as occurring in the fresh waters of South America, so that an analysis of the contents of this catalogue must relate chiefly to the genera and species. In so doing I first point out two genera which are characteristically marine, which have been shown by Günther and Steindachner to inhabit the Brazilian Amazon. I have proven that their distribution extends even to the Peruvian Amazon, 2500 miles from the sea. They are :

I. *Belone L. Tetrodon* L., represented by one species each.

I next enumerate four species which are confined to the Alpine waters of the Amazon, having been brought by Prof. Orton from the elevations of from 10,000 to 11,400 feet. These are :

II. *Arges sabalo,* C. V.
Trichomycterus dispar Tsch.
Trichomycterus gracilis C. V.
Tetragonopterus ipanquianus Cope.

These represent the two families of *Siluridæ* and *Characinidæ*, which are distributed everywhere in the neotropical realm. Of the *Characinidæ*, *Tetragonopterus* is universally distributed. Of the *Siluridæ, Arges* is Alpine, but whether found in the waters of the Pacific Slope as well as the Atlantic, I am not informed. The other genus, *Trichomycterus*, is Alpine and West Coast, occurring from Equador to Southern Chili. The two species enumerated above are the only ones from Atlantic waters yet known. This is one of the few cases where a West Coast form crosses the great water-shed. It is well known that many genera are common to the waters of both coasts, and even, according to Günther, the species *Macrodon trahira.*

I next note the genera which have so far not been found on the lower or middle Amazon, and which may be regarded as characteristic of the Peruvian portion of its course. This list is obviously only provisional, as exploration of the Amazonian basin has not progressed sufficiently to enable us to assert the restricted distribution of any type. Thus the genus *Otocinclus* Cope, first obtained from the Peruvian Amazon, has been ascertained by Steindachner to occur near Rio Janeiro. *Zathorax* and *Triportheus* first determined from western species, occur on the Lower Amazon. The genera remaining are:

III. *Siluridæ; Brochis* Cope; *Chænothorax* Cope; *Physopyxis* Cope; *Agamyxis* Cope; *Pariolius* Cope.

Characinidæ; Aphyocharax Gthr.; *Iguanodectes* Cope; *Stethaprion* Cope.

Finally, the species which have not yet been found below the Peruvian boundaries are as follows. I include species previously described by myself from Pebas, in the essay on The Fishes of the Ambyiacu River,* also those described by Gill from Orton's first collection, and by Günther from those of Bartlett.

IV. *Siluridæ*	44
Pseudorhamdia Blk	1
Pimelodus Lac	4
Euanemus M. T.	1
Epapterus Cope	1
Anchenipterus C. V.	3
Centromochlus Kner	1
Doras Lac	1
Zathorax Cope	2
Agamyxis Cope	1
Physopyxis Cope	1
Dianema Cope	1
Brochis Cope	2
Chænothorax Cope	2
Gastrodermus Cope	5
Hypoptopoma Gthr	3
Otocinclus Cope	1
Liposarcus Gthr	3
Plecostomus Art	3
Chætostomus Heck	5
Pariolius Cope	1
Trichomycterus	2
Aspredinidæ	3
Bunocephalus Kner	2
Dysichthys Cope	1
Characinidæ	53
Anodus Spix	2
Curimatus Cuv	5
Prochilodus Agass	2
Rœboides Gthr	3
Anacyrtus Gthr	3
Xiphorhamphus M. T.	2
Hydrolycus M. T.	1
Xiphostoma Spix	1
Characidium Reinhd	2
Aphyocharax Gthr	2
Schizodon Agass	1
Iguanodectes Cope	1
Odontostilbe Cope	1
Leporinus Spix	3
Hemigrammus Gill	1
Brycon M. T.	4
Tetragonopterus Cuv	6
Triportheus Cope	1
Stethaprion Cope	2
Chalceus Cuv	1
Serrasalmo Lacep	2
Metynnis Cope	1
Myletes Cuv	3
Pyrrhulina C. V.	1
Holotaxis Cope	2
Chromididæ	10
Acara Heck	6
Geophagus Heck	1
Crenicichla Heck	3
Total number of species not yet known below the Peruvian Amazon	120

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* Proceed. Philada. Academy, 1872.

ADDENDUM

PERCESOCES.

MUGILIDÆ.

GASTROPTERUS ARCHÆUS, Gen. et. sp. nov.

Char. Gen. A broad band of teeth on the premaxillary and dentary bones, and a patch on the vomer. Dorsal spinous fin with four rays. Ventral fins abdominal. Second dorsal opposite to anal. Dermal fold not crossing superior portion of premaxillary region, hence the jaws are only partially protractile.

This genus is an interesting form, probably of *Mugilidæ*, related to *Protistius* Cope, and *Myxus* Günther. The wide bands of teeth, consisting of numerous series, are not found in the last named genus, but belong to the first. Here, however, the spinous dorsal fin is rudimental, and there are no teeth on the vomer.

The pectoral fin has the elevated position usual in the *Percesoces*, but the ventral fin is more posterior than in *Mugil*, having the position usual in Physostomous fishes. The spinous dorsal fin is very small, and the caudal fin is forked. A lateral line of pores extends along the lower part of the side.

The characters of this genus render it probable that *Protistius*[*] should be referred to the *Percesoces*. These forms add to the number of existing relationships between the cold blooded vertebrate faunæ of Australia and the West Coast of South America.

Char. Specif. Radii. D. IV. I. 11; A. I. 15; V. I. 5; P. 15. The dorsal spines are very small, the first about as long as the diameter of the orbit, and originating above a point half way between the bases of the ventral and anal fins. The pectoral fin is wide, and extends three-quarters way to the base of the ventral. The latter extends three-fifths the distance to the anal fin. The anterior rays of the anal are much longer than the posterior, and the margin is concave. Caudal lobes sub-equal and acute. Scales, counting from spinous dorsal to ventral fin; 20-93-3. Anterior to the ventral fin the scales become smaller and rather irregular along the lateral line. Between the occiput and first dorsal spine there are 50 rows. The top of the head is scaled to the line of the anterior borders of the orbits.

The muzzle is prominent and parabolic in outline, projecting very little beyond the mandible. The outline of the latter is similar to that of the muzzle, and the mouth is horizontal to a point a half the eye's diameter in front of the orbit, where it is cut off by the decurvature of the premaxillary bones. Orbit one-fifth the length of the head, and 15 times in length of muzzle, which is one mm. less than the slightly convex interobital space. The length of the head enters the total minus the caudal fin, four times; the greatest depth of the body enters the same, six times. Total length M. .166; of the head, .035; to origin of ventral fin, .063; of anal fin .090; of second dorsal fin, .096; of caudal fin, .141.

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[*] Proceed. Academy Phila., 1874, p. 66.

Besides the generic characters mentioned, this species differs from the *Protistius semotilus* of the same region, in the larger number of soft rays, the smaller eye, narrower interorbital space, etc. The lateral line is better defined in this species, but is not continued beyond the anal fin; a few isolated tubes occur on scales on other parts of the sides.

The color of the *Gastropterus archæus* is silvery, darker shaded on the upper surfaces, and without spots on the body or fins.

Two specimens; coll. of 1874; obtained by Prof. Orton, at Arequipa on the Pacific slope at an elevation of 7500 feet.

Radiation and Rotation.

By Pliny Earle Chase, LL.D.,

Professor of Philosophy in Haverford College.

(*Read before the American Philosophical Society, June* 21, 1878.)

Among the most interesting of the unsolved astronomical problems, are the questions as to the origin of solar radiation and of cosmical rotation. These two problems, as I have already shown, are intimately connected, at the centre of our system, by the ultimate equality which exists between the velocity of light, the limiting centrifugal velocity of solar rotation, and the velocity of complete solar dissociation.

It has been commonly assumed that physical forces tend to ultimate equilibrium and consequent complete stagnation. The imperfections of any plan which looks to such a final result, have led some writers to suppose that there may be some compensating provisions, hitherto undiscovered, for a renewal of activity. In the search for such provisions, the equality of action and reaction and the possibility that the compensation is continually furnished, by Him who is ever "upholding all things by the word of His power," seem to have been wholly overlooked.

If we assume the existence of a luminiferous æther, whether as a reality, or as a convenient representative of co-ordinated central forces, its undulations, when obstructed by inert centres, would necessarily lead to such phenomena as those of gravitation, light, heat, electricity, magnetism, etc. Confining ourselves for the present to the action of gravitation, it is well known that the limiting velocity of possible gravitating action and consequent centrifugal reaction, at any given point, is $\sqrt{2gr}$, the velocity varying as $\sqrt{\frac{1}{r}}$.

If, according to the hypothesis of Mossotti, each particle is provided with a definite æthereal atmosphere, the density of that atmosphere in a condensing nucleus, should vary as $\frac{1}{r^3}$. But according to Graham's law, $v \propto \sqrt{\frac{E}{D}}$. Therefore, in order to satisfy the conditions of gravity, the æthereal elasticity, within any nucleus which is either wholly or almost wholly gaseous, $\propto \frac{1}{r^4}$.

Since such is the supposed character of the solar nucleus, it seems not unlikely that the centrifugal radiations of any heavenly body being at all times equivalent to the centripetal radiations which it intercepts, solar and stellar light and heat are only the reactionary consequences, of such perpetual internal oscillations as the æther has first transmitted to the luminous orbs and then resumed. The fact that the reaction, which is shown in the centrifugal force of solar rotation, and the action which is shown in parabolic orbital velocities, find a common limit in the velocity of light, may perhaps be regarded as a crucial test of this hypothesis, which is further strengthened by the following considerations.

In the huge comet-like nebulosity which is indicated by the solar-stellar paraboloid, the interesting relation which has been pointed out by Stockwell,* between the perihelia of Jupiter and Uranus, and the many indications of normal "subsidence," which I have shown in previous papers, suggest the probability of an early ellipsoidal nucleus, with subordinate nucleoli ; the major axis of the nucleus being bounded by 2 Ψ$_5$ (60.939) and 2 ♅$_5$ (41.358), and the Sun being in the focus. The *vis viva* of condensation would give velocities of incipient orbital separation at Ψ$_5$ (30.470) and ♅$_5$ (20.679), and ♃$_1$ would then be in the centre of the entire system (30.470—20.679 ÷ 2 = 4.885 ; ♃$_1$ = 4.886), even as ⊕$_3$ is nearly in the centre of the secondary system (♂$_5$ + ☿$_1$ ÷ 2 = 1.017).

If we apply Gummere's criterion ($n = 11.656854$), we find that three prominent centres of "subsidence" were determined by this early ellipsoidal nucleus. For 2 Ψ$_5$ ÷ n = 5.228, ♃$_3$ being 5.203 ; 2 ♅$_5$ ÷ n = 3.548, which is near the outer limit of the asteroidal belt, ⑩⑦$_3$ being 3.560 ; (Ψ$_1$ — ♅$_1$) ÷ n = 1.022, the centre of the secondary system being, as above stated, 1.017. The Earth is still in the centre of a "subsidence" ellipsoid, of which the sun is in one focus, while the outer asteroidal region (8.2028) and ♃$_3$ (5.2028) are at opposite apsidal extremities of the major axis. Moreover, 3.2035 is the extremity of an atmospherical radius which would move with the velocity of light, provided the sun's surface were moving with orbital velocity, or the velocity of incipient dissociation ($\sqrt{gr}$).

It seems probable that in consequence of subsidence, Jupiter, which, as we have already seen, was the centre of nucleal volume, may have been also the centre of nucleal mass, at the time of its complete orbital separation and that it was, therefore, the primitive Sun of the extra-asteroidal planets, before it became our Sun's "companion-star." For with the present mass of the system, and with a mean radius vector $= \Psi_1 + ♃_1$ (34.4845), the orbital period of Neptune would be 73966 days. Two successive subsidences ($34.4845 \div n^2$) would bring the solar nucleal surface to about $\frac{2}{3}$ of $☿_3$, or 54.53 solar radii. The angular acceleration of rotation, due to subsequent nucleal contraction, would $\propto \frac{1}{r^2}$. Therefore, when the Sun had contracted to its present limits, its rotation period would be $73966 \div 54.53^2 = 24.88$ days.*

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*Smithsonian Contributions, 232, xiv.

If this were the only coincidence of its kind we might, perhaps, have some good grounds for looking upon it as merely curious and accidental. But the bond of connection, which we have already found between rotation and revolution, in the limiting formative undulations which are propagated with the velocity of light, may prepare us for accepting evidences of a similar bond in the phenomena of nebular subsidence.

There are three other known systems of cosmical rotation, which may help us to judge as to the rightfulness of such an acceptance, viz.: that of the extra-asteroidal planets, with an estimated average period of about 10 hours; that of the intra-asteroidal planets, with an estimated period of about 24 hours, and that of the moon, with a synodic period of 29.5306 days. If these periods are dependent upon the same subsidence which led to the early belt formations, we may reasonably look for evidence of that dependence of a character similar to that which we have found in the case of the sun.

We have seen that the first subsidences from 2 Ψ and 2 ♃, account for the orbital ruptures of Jupiter and the Earth; secondary subsidences from points within the orbital belts, account for these three rotation periods. For $♃_5 \div n = 101.73$ solar radii and Jupiter's orbital revolution (4332.585 dy.) $\div 101.73^2 = 10^h.05$; $⊕_4 \div n = 19.66$ solar radii and Earth's orbital revolution (366.256 dy.) $\div 19.66^2 = 24^h.205$; $☽_4 \div n = 5.442$ Earth's radii and Earth's rotation $\times 5.442^2 = 29.619$ dy. In these accordances we have additional evidence of the equality of action and reaction.

The normal character of rotation is still further traceable, even after the formation of the subordinate planets in the two principal planetary belts. If we seek the point of incipient condensation, which would lead to such rotation periods as have been generally assigned by astronomers to the different planets, we readily find that Gummere's criterion, Newton's third law, and the law of equal areas, lead to the formula $n\left(\frac{T}{t}\right)^{\frac{1}{2}} = \frac{R}{\rho}$, in

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*These relations may have an important bearing on Croll's hypothesis of the origin of solar radiation. In the stellar-solar paraboloid, of which traces still exist between Sun and *α Centauri*, there must have been frequent collisions. Some of Croll's critics have shown strange misapprehensions as to the possible velocity of collision. The limit of possible relative velocity, from the simple gravitation of two equal meeting masses, is $2\sqrt{2gr}$. This would be equivalent, taking the values of g and r at Sun's apparent surface, to $.01774\,r$, or more than 750 miles per second. If projection were added to gravitation, or if the two masses had small solid nuclei of great density, while the greater part of their volume was gaseous, or if there were a large number of equal masses, the limit of possible velocity might be largely increased.

which n = Gummere's criterion ; $\frac{T}{t}$ = number of planetary rotations in one orbital revolution ; R = radius of nebular contraction ; ρ = Sun's present radius. Taking Herschel's values for T and t we have

	$n\left(\frac{T}{t}\right)^{\frac{1}{2}}$		$\frac{R}{\rho}$ (1)		$\frac{R}{\rho}$ (2)
☿	110.4	☿$_5$	102.4	½⊕$_4$	111.1
♀	177.6	♀$_5$	166.4	½♂$_4$	176.6
⊕	223.1	⊕$_4$	222.2		
♂	301.8	♂$_2$	301.5		
(3)	445.4	(3)	427.1 to 719.4	2⊕$_4$	444.4
♃	1192.5	♃$_5$	1185.9		
♄	1829.5	♄$_1$	1876.7		
♅	3245.7			½♆$_4$	3258.9

It thus appears that :

1. All the points of incipient condensation, $\frac{R}{\rho}$ (1), are within Kirkwood's "spheres of attraction."

2. In the pair of extra-asteroidal planets which are nearest the asteroidal belt, the incipient points are near the *secular* aphelion of the inner, and the *secular* perihelion of the outer planet.

3. In the pair of intra-asteroidal planets which are nearest the asteroidal belt, the incipient points are near the *mean* aphelion of the inner and the *mean* perihelion of the outer planet.

4. The sum of the radii of nebular contraction, for the two principal planets of the solar system (1192.5 + 1829.5 = 3022), is almost precisely equivalent to the sum of the mean perihelion radii of the same planets (♃$_2$ 1069.6 + ♄$_2$ 1950.4 = 3020).

5. The secondary points of incipient condensation, $\frac{R}{\rho}$ (2), are all referable, through the simple accumulation of *vis viva*, to primary mean aphelia.

6. The significance of the fourth accordance is increased by Stockwell's discovery,* that "the mean motion of Jupiter's node on the invariable plane is exactly equal to that of Saturn, and the mean longitudes of these nodes differ by exactly 180°."

7. Gummere's criterion confirms the theory of Democritus, that the evolution of worlds was due to a vortical movement, which was generated by the descent of the heavier atoms through the lighter.

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* Loc. cit.

Letter of Dr. Alexander Wilcocks on Shadows Without Penumbra, read February 1, 1878.

EVAN HALL, NEAR DONALDSONVILLE, LOUISIANA,
26th January, 1878.

To the Secretaries of the American Philosophical Society.

I have within the last few days witnessed a phenomenon which I had diligently looked for in vain for more than forty years, viz.: The Production of a Shadow by the light of a Planet.

The body which occasioned the shadow was the planet Venus, and the circumstances under which it was seen were exceptionally favorable.

The Sun having been below the horizon an hour and a half; the Moon not having risen; the atmosphere being very clear, and the planet shining brightly in the south-west, I was passing along a white wall which faced in that direction, and saw distinctly my shadow moving upon the wall.

There are some particulars in which a shadow produced by a planet should differ from the shadows caused by the other celestial luminaries. To our unassisted vision the planets practically occupy mere points in the heavens (their apparent diameters being only an optical illusion).

The Sun and Moon having each of them a diameter which occupies about half a degree of space in the celestial hemisphere, the shadows thrown by these luminaries can never be sharp and well defined. Every such shadow must have a penumbra.

Now in the shadows produced by Venus there is no penumbra. The shadow of a hand distant twelve feet from the wall I found perfectly sharp and well defined; and more striking still, the shadows of the twigs of a Pecan tree distant fifty yards were also sharp. These last shadows were faint from the effect of the diffused light from the sky, which illumined the wall.

When in sunlight two objects are made to approach each other, there appears between their shadows a dark process which connects the two before the bodies actually come together.

In the shadows produced by Venus nothing of the kind takes place.

In sunlight a man's finger held twelve feet from a screen has a shadow consisting entirely of penumbra. The umbra has vanished.

The shadows produced by Venus are exclusively umbra.

The above observations and reflections may have been made by others; if so, they have not fallen under my notice.

P. S.—A few daws after the above remarks were penned, when the new moon was beginning to throw' visible shadows, I had an opportunity to compare the strength of these with those produced by Venus.

The shadows caused by the primary planet were sharper and stronger than those thrown by our satellite.

Very Respectfully yours,

ALEXANDER WILCOCKS.

CONTRIBUTIONS FROM THE LABORATORY OF THE UNIVERSITY OF PENNSYLVANIA.

No. XIV.

I. A new Monochlordinitrophenol and an Aniline derivative of a-Monochlordinitrophenol. II. Beryllium Borate.

By Edgar F. Smith.

(Read before the American Philosophical Society, June 21, 1878.)

When fuming nitric acid is allowed to act upon pure monochlorsalicylic acid, there is produced not only the corresponding monochlornitrosalicylic acid (in small quantities), but the nitration usually extends so far as to cause the carboxyl group to disappear, and two nitro-groups enter, leaving us a monochlordinitrophenol. The formation of this latter compound was first effected in this manner by Rogers (Inaugural Dissertation, Gottingen, 1875). The phenol showed a constant fusing point of 79°-80° C., was rather insoluble in cold water, more readily soluble in warm, and crystallized from its aqueous solutions in long yellow needles.

The salts of this acid are very beautiful, but it will suffice for our purpose to mention only the potassium derivative, which separates from its solutions in long, beautiful silky-red needles, without any water of crystallization.

The above phenol and its potassium salt I also produced, but, after working with the latter for some time, I suspected the presence of another compound, and by repeated re-crystallization from aqueous solutions I finally obtained not only the red potassium salt, but a similar compound which separated in large bundles consisting of orange-colored needles. These, after being completely separated from the red salt, were subjected to an analysis to ascertain their constitution.

Analysis of the red colored salt.

.1691 grms. salt, dried at 130° C., were placed in a platinum crucible, a few drops of conc. sulphuric acid added, and a gentle heat applied. The K_2SO_4 that remained $=$ .0264 grms., which corresponded to 15.60% potassium. The salt is anhydrous. The calculated percentage of K in $C_6H_2Cl(NO_2)_2OK$ is 15.23%. There was, therefore, no doubt as to the constitution of this salt.

Monochlordinitrophenol.

Fusing point 80° C.

The free acid crystallized from aqueous solutions in long yellow needles, which fused at 80°C and solidified again at 69°C. It is also identical with the phenol of Rogers (see above) and the a-Chlordinitrophenol of Faust and Saame (Annalen der Chemie u. Pharmacie, 1870. 7 Supplementband. 2 Heft S. 174).

Analysis of the yellow colored salt.

Water Determination.—.1617 grms. air dried salt lost upon heating at 140° for four hours .0168 grms. $H_2O = 10.39\%$. 1½ mols H_2O require 9.53%.

Potassium Determination.—.1449 grms. substance gave, upon evaporation with sulphuric acid, .0480 grms. $K_2SO_4 = 14.86\%$ potassium. From this we see that this salt is also a derivative of a monochlordinitrophenol. The formula is $C_6 H_2 Cl (NO_2)_2 OK + 1\frac{1}{2} H_2O$.

This salt is much more soluble than the red compound. The color of the latter is so intense as to entirely obscure the yellow, which consequently is overlooked unless great care is exercised in re-crystallizing the red compound.

MONOCHLORDINITROPHENOL.

Fusing point 79°–80°C.

Upon mixing a cold solution of the yellow salt with dilute nitric acid the corresponding phenol separated in yellowish colored masses, which upon being washed and re-crystallized several times from aqueous solutions, separated in rather long lemon-yellow colored needles. The fusing point of this compound remained constant at 79°–80°C. The point of solidification was 25°C., considerably lower than that of the acid corresponding to the red needles. In cold water the acid is rather insoluble, readily dissolved on heating.

Another difference noticed between the free acid from the red silky needles, and that just above described is in the silver salts. The former yields a soluble salt crystallizing in long bright red colored needles, the latter one separates out in bronze colored needles which possess a marked metallic lustre.

This new Chlordinitrophenol is usually formed in very small quantities, therefore I have not been able to subject it to as thorough an investigation as I desired. The material with which I worked was, however, perfectly pure, and as I have obtained the compound at various times, and the analytical results being the same on all occasions, I do not hesitate to announce the above acid as another of the many possible compounds having this composition. In regard to the position of the (NO_2) groups I cannot as yet give any definite information.

a-MONOCHLORDINITROPHENOL-ANILINE.

A small quantity of a-Chlordinitrophenol was mixed with sufficient aniline to dissolve the former in the cold. As soon as the two compounds were brought in contact the solution assumed a beautiful red color, which imparts to the skin a rather difficultly removable yellow stain. The solution was gently warmed on a water bath for ten minutes, and the liquid then poured from the flask containing it into a rather large watch glass and allowed to cool. Upon cooling there separated hard nodular crystals, which were pressed well between paper and dried by exposure to the air, then dissolved in warm water, from which, on cooling, long curled light-yellow needles separated. The fusing point of this compound after repeated re-crystallizations remained constant at 137°C. When solutions of the compound in water are boiled hard aniline separates out. An analysis of the substance indicated it to be a union of one mol. chlordinitrophenol with a like amount of aniline—$C_6H_2Cl(NO_2)_2CH.\ C_6H_5NH_2$.

Analysis.—.1221 grms dried substance burned with lead chromate gave .0188 grms. Carbon = 46.19 % C. The hydrogen determination was lost. The theoretical percentage of carbon demanded by the above compound is 46.22 % C.

With the ammonia-cobalt bases of Genth and Gibbs, a-Monochlordinitrophenol yields exceedingly beautiful compounds. My results in this direction will be given later.

BERYLLIUM BORATE.

Some time ago I was working with beryllium and added to a solution of its chloride an excess of a rather concentrated borax solution. An immediate precipitation was the result. The precipitate was thrown upon a filter and washed with hot water, until a drop of the washings evaporated upon platinum foil left no residue.

The precipitate was dried and tested for boracic acid, but this was not found present. Another portion of the same precipitate subjected to an analysis proved it to be nothing more than beryllium hydrate, consequently if the borate had been at first produced, the subsequent boiling with hot water had decomposed it.

Another portion of the beryllium chloride was treated in a similar manner. The precipitate was brought on the filter to allow the liquid to drain off, and then rinsed with cold water into a small flask, water added, and allowed to stand for some time—being occasionally shaken. The precipitate was then brought on to a filter and dried by exposure to the air.

Boracic acid was found present when the tests were made.

Analysis gave me the following percentages of beryllium oxide: 6.98 BeO and 6.89 % BeO.

The boracic acid was not estimated.

MAY 23, 1878.

Stated Meeting, March 15th, 1878.

Present, 14 members.

Vice-President, MR. FRALEY, in the chair.

Photographs for the album were received from Mr. C. H. F. Peters, Director of the Litchfield Observatory, and Professor of Astronomy at Hamilton College, Clinton, N. Y.

Also from Prof. John Wm. Dawson, LL.D., F. R. S. & F. G. S., Principal and Vice-Chancellor of the McGill University, Montreal, Canada, and from Mr. Sam'l F. Haven, Worcester, Mass.

Letters of acknowledgment were received from the New Hampshire Historical Society, dated Concord, March 9th, 1878 (100), and the Franklin Institute, March 12th, 1878 (100), and postal cards from many other correspondents.

A letter of thanks for the use of the Hall on the evening of February 26th, was received from Dr. Thomas M. Drown, Secretary, dated Easton, May 9th, 1878.

A letter from the State Historical Society of Kansas, dated Topeka, February 27th, and signed F. G. Adams, Secretary, giving a list of State publications at the command of that Society, and proposing exchanges. On motion the name of the Society was ordered to be placed upon the list of correspondents to receive the Proceedings.

A letter (P. C.) was received from Prof. Henry S. Osborn, State University, Oxford, Ohio, offering a donation of fossils to the Cabinet.

Donations for the Library were received from the Mining Bureau at Melbourne; the Academies at Berlin, Brussels, Rome, Minneapolis, and Chicago; the Geographical Societies at Paris and Bordeaux; Revue Politique; London Nature; Essex Institute; Boston N. H. Society; Silliman and Dana; Long Island Historical Society; Mr. J. C. Bancroft Davis of New York; the Geological Survey of New Jersey; the Franklin Institute, Penn Monthly, Medical News, Medical Journal of Pharmacy, Mr. Henry Philips, Jr., and Mr. Persifor Frazer, Jr., of Philadelphia, the Light House Board and Department of State at Washington; Wisconsin State Historical Society; Minnesota Historical Society, and Ministerio de Fomento, Mexico.

The death of Gen. Joseph G. Swift, on July 23d, 1865, at Geneva, New York, aged 82, was announced by letter from Prof. Henry Coppée.

The death of Prof. Theodore Strong in 1871 or 1872, was reported by Prof. Thomas Hill, of Portland.

The death of Lord Mahon, Earl Stanhope, in 1875 (?) was reported by Mr. H. Armitt Brown, and others.

The death of Prof. Charles E. Anthon, at New York, and the death of Mr. Wm. H. Grinnell were also reported.

Prof. Sadtler made an explanation in reply to certain published criticisms by Prof. Morton, of Hoboken, N. J., relative to Prof. Sadtler's gas analysis of 1877.

Mr. Lesley placed on record Mr. Sherwood's Devonian Section, made at Catskill and along Scoharie Creek some years ago under the orders of Prof. James Hall, who has permitted its publication.

Pending nominations Nos. 852 and 853 were read.

Mr. Price presented a report from the Committee on the Michaux Legacy, with recommendations, which, on motion, was approved, and the appropriations passed.

The Committee on the Michaux Legacy respectfully report:

That at a meeting held the 15th of March, 1878, (present Tilghman, Smith, Townsend, Price), the syllabus of Dr. Rothrock's lectures was approved, and recommended to the Society, for approval and publication with 500 extra copies for circulation, and that the lecturer be advertised by handbills and in not over five newspapers.

Also that appropriations be made as follows:

For Dr. Rothrock, two hundred and eighty ($280) dollars.

Advertising, fifty ($50) dollars.

And for planting sixty ($60) trees from Michaux importations, within the University grounds sixty ($60) dollars.

Signed, ELI K. PRICE, *Chairman.*

Stated Meeting, April 5th, 1878.

Present, 16 members.

Vice-President, Mr. E. K. Price, in the chair.

Letters of acknowledgment were received from U. S. Naval Observatory, March 20 (100 and list); Leo Lesquereux, March 16 (100 and list); and the Chicago Historical Society, March 15 (100 and list).

A letter acknowledging the receipt of boxes (4) of transmissions for foreign distribution was received from the Smithsonian Institution.

Letters of envoy were received from the Royal Institute, London, March 12; Mr. C. A. Kesselmeyer, March 17; Dr. T. Sterry Hunt, March 20; Mr. I. B. Pearce (Geol. Sur., Pa.), March 18; and Mr. W. B. Taylor, Washington, D. C., March 28, 1878.

A letter applying for the Coal Slack prize was received from Mr. Benj. F. Bee, dated Harwich, Mass., March 23.

A circular letter was received from the University of Pavia.

Donations for the Library were received from the R. Acad., Turin; Geographical Society, and Annales des Mines, Revue Politique; and Commercial Geographical Society, Bordeaux; the editors of the Revista Euskara at Pamplona; R. Astronomical Society and London Nature; Dr. Fred. Bateman, Norwich, England; Mr. C. A. Kesselmeyer, Leipsic; Museum of Comp. Zool., Cambridge, Mass.; Mr. Samuel H. Scudder, Boston; D. T. S. Hunt, of Boston; Free Pub. Lib. New Bedford; Am. J. S. and A.; Prof. W. A. Norton, New Haven; Franklin Institute, College of Pharmacy, Penn Monthly, Medical News, American Journal of Medical Sciences; Board of Com. of the Second Geological Survey of Pennsylvania; Chief of U. S. Engineers; Mr. W. B. Taylor, Washington; Dr. Robt. Peter, Lexington, Ky., and Ministerio de Fomento, Mexico.

An offer to sell to the Society a complete set of the Phil.

Trans., R. S., London, 164 Vols. in calf, for $1500,* was made by Mr. P. Munzinger, 1908 Rittenhouse Square.

Mr. Cope made some remarks upon North American species of extinct Rhinoceroid mammals, and exhibited specimens to illustrate their different characters.

Mr. Cope then spoke of the extinct vertebrata of the Permian System of the United States.

A second communication was received from Dr. Gatschet of Geneva, "On the Timucua Language.

Prof. Frazer communicated to the Society a set of carefully calculated tables for common use, converting the weights and measurements of the metric system into those commonly employed in the United States, and *vice versa.*

Prof. Frazer promised to give at a future meeting the full details of a microscopic examination of the marks made by the phonograph on tin foil.

Prof. Sadtler communicated his remarks on gas analyses alluded to at the last meeting.

Prof. Sadtler communicated a paper by Dr. John Marshall, entitled "A study of some of the derivations of Mono- and Dichlor-Salicylic Acid," as a "Contribution from the Laboratory of the University of Pennsylvania, No. XIII."

Mr. Britton called attention to the forms in which Carbon existed in iron and steel.

He referred to the two well-known, the combined and graphitic, and also to a third form or semi-graphitic. The latter he had found in poorly puddled metal, and also in Siemens-Martin steel, and more recently in Bessemer steel rails that had not given satisfaction, and in some pig iron produced when the furnace was working abnormally. The semi-graphitic form could be separated and collected by treating the metal containing it with dilute sulphuric or hydrochloric acid without the application of much heat until all the iron became dissolved, and then filtering the solution; it would be on the filter, but in appearance not so black as the graphitic; would have a reddish tinge, that, upon ignition would leave the ash of the paper white. By boiling from ten to thirty minutes all of it appears to dissolve. Mr. Britton illustrated the behavior of this third form of carbon by producing several glass tubes, in some of which it was not dissolved in the acids mentioned, and in others scarcely any of it was observable after being boiled for twenty minutes. The existence of more than two forms of carbon in iron and steel was observed by him several years ago, but he believed that it was not generally credited. It was a source of error in determining carbon by the colorimetric method. He proposed to make further investigation by analyses, and to communicate his results.

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*Mr. M. paid $2000 for this set.

The Committee on the Michaux Legacy reported that they had purchased and presented to the Fairmount Park Commission, for Horticultural Library, the North American Sylva, by Michaux and Nuttall.

Prof. Cope moved the appointment of a committee to examine and report on the merits of his paper, reported on adversely to its publication at a previous meeting. After discussion of the motion by Messrs. Cope, Frazer, Briggs and LeConte, the consideration of the subject further was, on motion of Dr. LeConte, postponed to the next meeting.

Pending nominations Nos. 852 to 856 were read and the meeting was adjourned.

Stated Meeting, April 19th, 1878.

Present, 15 members.

Vice-President, Mr. E. K. Price, in the chair.

A letter acknowledging the receipt of Nos. 96, 97, 98, was received from the Royal Academy at Amsterdam, dated Oct. 20, 1877.

Letters of envoy were received from the same, Nov. 13, 1877; the Royal Zoological Society, Amsterdam, Feb. 1, 1878; the Society at Marburg, Jan. 1; and the Royal Observatory at Bruxelles, Oct. 1, 1877.

A letter was received from the Fairmount Park Commissioners acknowledging the gift of the Michaux and Nuttall Flora Americana, for the Park Library, dated April 13, 1878.

Donations for the Library were received from the Academies at St. Petersburg, Berlin, Amsterdam, Bruxelles, Rome and Philadelphia; the Zoological Society at Amsterdam; the German Geological and Horticultural Societies in Berlin;

the Societies in Ulm, Cassel and Marburg; M. Henri de Saussure; the Royal Institute at Luxembourg; the Observatories at Oxford, Bruxelles and Cincinnati; the Geological Commercial Society at Bordeaux; the Geographical and Meteorological Societies, Victoria Institute and London Nature; the Royal Society at Edinburgh; the Royal Geological Society at Dublin; the Boston Natural History Society; American Antiquarian Society; Prof. James Hall; Pennsylvania Magazine of History and Biography; Mr. M. Russell Thayer of Philadelphia; Mr. E. A. Barber and Prof. J. J. Sylvester of Baltimore.

Mr. Lesley read extracts from a letter from Prof. E. Desor, of Neufchâtel, respecting the discovery of "pierres à ècuilles," or rocks with cup sculptures, in the vicinity of Lyons, in Dauphiné, Thuringen, the Altmarck, Pomerania, Mecklenburg, Hanover, Bohemia, and Lower Austria.

"In Sweden where they go by the name of *Elfenstenar* people at this day carry to them all sorts of offerings and anoint them with lard against diseases (smorja sten for sjukdom) (Siegthum).

"But what is particularly interesting is the discovery recently made of similar cups on the walls of the old churches of Northern Germany, even when the walls are built of bricks, as is the case on three of the old churches of Greifswald." [Sketches were shown of several brick courses with groups of cups.*] "It is another instance of that habit of the Christian apostles to borrow all sorts of practices from heathendom and apply them to their own cultus."

Mr. Franklin Platt communicated a section of the Palæozoic rocks of Blair Co., Pa., measured and compiled during the last season's work of the Geological Survey, by Mr. Sanders.

Prof. Frazer described pot holes and Indian cup sculpture on the shore and island rocks of the Susquehanna River; and Dr. LeConte described the pot holes produced by wave movements on the north shore of Lake Superior.

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* Näpfchen and Rillen on the Churches of Griefswald, by Dr. Fiedel.

Dr. LeConte communicated two more lists:

1. List of Coleoptera found in the Lake Superior region, by H. G. Hubbard and E. A. Schwarz.

2. Contribution to a list of the Coleoptera of the Lower Peninsula of Michigan, by the same.

Dr. Horn communicated two papers:

1. Synopsis of the *Colydiidæ* of the U. S.

2. Revision of the species of the sub-family *Bostrichidæ* of the U. S.

Prof. Frazer threw upon a screen, by means of Mr. Holman's calcium light with microscope, magnified reflections of the pits in tin foil produced by the stylus of a phonograph, and showed by a discussion of their shapes that different vowels and vowels of different time lengths had different and constant characteristic marks visible to the eye, that these marks were single, double and triple, always connected in the same manner and order. Even the resolution of diphthongs appeared possible. His experiments were made with the assistance of Mr. Plush of Philadelphia, and on his phonograph.

Prof. Frazer also recorded a new use of the "Edison transmitter" for measuring amounts of pressure by means of the galvanometer.

Pending nominations, Nos. 852 to 856 were read, and on motion the regular election of members was postponed to the next meeting.

And the meeting was adjourned.

Stated Meeting, *May 3d*, 1878.

Present 13 members.

Vice-President, **Mr. Fraley**, in the chair.

Photographs for the Album were received from Prof. F. A. March, of Easton, Pa; Prof. T. M. Drown, of Easton, Pa; Prof. W. C. Cattell, President of Lafayette College, Easton, Pa.; Prof. Thomas Conrad Porter, of Easton, Pa.; and President F. A. P. Barnard, of Columbia College, New York City, with a letter from the same.

A letter of acknowledgment was received from the Royal Academy of Sciences in Lisbon, dated March 12, 1878 (96, 98).

A letter was received from the Count de Toronas, dated Madrid, April 16th, 1878, announcing the transmission of a donation for the Library, as a mark of friendly sympathy with the objects of the Society.

Donations for the Library were received from the Society at Ulm; Revue Politique; Commercial Geographical Society at Bordeaux; Flora Batava; Astronomical and Antiquarian Societies of London; Editors of Financial Reform Almanac and Nature; Boston Natural History Society; Museum of Comparative Zoology; Editors of Plumber and Sanitary Engineer, New York; Mr. W. E Dubois of Philadelphia; Dr. Henry Hartshorne; U. S. Geographical and Geological Survey of the Territories, and Ministerio de Fomento, Mexico.

The following communication was made by the Secretary, "A detailed section of the rocks included between the lower productive coal measures and the dark shales of the Devonian, in the vicinity of Renova, Clinton Co., Pa., by H. M. Chance, of the Geological Survey of Pennsylvania."

The Secretary read portions of a letter from Mr. W. D. H. Mason, Williamstown, Pa., describing the circumstances of his recent discovery of reptilian footprints on a slab of slate rock from the shaft of the Ellengowan Colliery, overlying the mammoth anthracite coal bed, in the Mahanoy Valley, Schuylkill Co., Pa., the original being in the possession of Mr. Lorenz of the Reading R. R., to be deposited in the museum of the Academy of Natural Sciences.

Letter of Mr. Wm. D. H. Mason, C. E., of Williamstown, Dauphin County, Pennsylvania, on the Batrachian Foot-tracks from the Ellengowan Shaft in Schuylkill County, Dated April 5, 1878.

As an additional link added to knowledge in the mystery attending the process of creation going on during the coal formation, in which geologists have heretofore been almost unanimous in doubting the existence of higher animal life, the finding of the singularly clear fossil Batrachian foot-marks imprinted on the gray slaty sandstone overlying the mammoth seam of coal, which have for some time past been exhibited in the office of W. Lorenz, Esq., Chief Engineer of the Philadelphia and Reading Railroad Company, were placed in his care for critical examination by those interested in such discoveries, previous to being presented by Mr. Lorenz, on my behalf, to the Academy of Natural Sciences at Philadelphia.

These foot-marks might easily be mistaken by people in general for those made by a small bird, on account of the three toes on the front and one at the back part of the foot with the joints and curved nails or claws, which are distinctly shown by their deeper indentations on the stone. The cushion-like ball of the foot aids the deception ; but the regular alternation of front and hind, right and left feet, each on their own line, as made by four-footed animals of the kind, dispels the idea of a biped.

These foot-prints were found on the 15th of June, 1876, at Ellangowan colliery, owned and operated by the Philadelphia and Reading Coal and Iron Company, situated in E. Mahanoy Township, Schuylkill Co., Pa., about midway between Mahanoy City and Shenandoah, in a small valley diverging from the Mahanoy valley proper. In this valley a split of the mammoth seam occurs which can best be explained by the mining engineers of the C. & I. Co., who have access to the maps and mines with all their secrets, splittings and ramifications, together with all the peculiarities, depth and thickness of rock and coal seams at that point.

Inquiry, at the time, of the bosses of the colliery, elicited the bare information that the rocks amongst which the specimen was found, had been taken from the shaft while it was being sunk and overlaid the mammoth : but they could give nothing definite as to depth below the surface, or position. My own impression is, that it was taken from the upper and most shelly or shale-like portion of this stratum of slate ; this opinion being based upon the fact that the most noticeable peculiarities exist mainly in its upper portion. Of these peculiarities, the frequent occurrence of nodules of hematitic iron and occasional ripple marks are the most prominent. In fact, it was by the observation of these characteristics that I was led to search among the rocks lying around, that the footmarks were found, and. if not destroyed by the burning of the breaker last fall, the other portions of the same rock still remain there. The piece bearing the marks was much larger than it now is and was trimmed down for convenience in carriage, though the foot-marks were all preserved and all I cared for.

It had been lying under the eaves of a shed, subjected to the dripping of water therefrom for several years, and close to the path leading around the shed, and by which path the mules were driven when used at the breaker. Only a portion of one foot was first visible, but by carefully removing thin films or scales of slate, the others were brought out. So cautiously did I work, that the impressions on the upper scales were destroyed, because too thin, and the danger of injuring those on the body of the stone. The fear of injury was so strong, that I only felt sure of my prize when it was safely deposited in my room at the hotel. Habitual search for fossils when about a rock bank of a coal mine, or where slates and shales present any indication of fossil remains, led me to search around on the occasion of this find which solves so knotty a problem.

The frequent occurrence of nodules of iron in different rocks, shales, or argillaceous deposits, I have never seen ascribed by any writer I have had access to, to any cause other than the accidental collection of ferruginous matter by molecular attraction; but in the center of such nodules, some definite shape is often found; sometimes a leaf, an insect or only a grain of sand; or, the interior cavity may be filled with ocherous or argillaceous matter.

In the old red sandstone, fossilized fish and plants most frequently show a casing or thin cover of a strongly ferruginous nature, which decreases in strength with increased distance from the center of the cast in the same ratio as one color is blended into another by the artist.

In the slates and fine sandstones where nodules appear, they either have a cavity of loose, ocherous matter—a pyritous speck or a mass of small, strongly sulphurous pyrites in crystals—sometimes only a grain of sand; and in the coarser sandstones between the coal seams, the plants exposed on their surface present a dark brown appearance, which shows a red streak when the film is thick enough to bear scratching.

Balls found in the slates and fine sandstones vary in shape as they do in size, from a perfect sphere, to irregular oblongs of every imaginable form.

Now, taking the abundance of fossil fish and other organic remains found in some portions of the old red sandstone, may we not reasonably suppose that the gray, slaty sandstone, overlying the mammoth coal seam, lying low down in our anthracite coal measure, has, in like manner been a receptacle for the remains of animal life; although these remains present to the eye more of the appearance and form of potatoes than animal remains? Is it not possible that by partial decomposition and chemical action upon their tissues and bones, they were converted into a pulpy or gelatinous substance which, by the action of the water in which they were floated or by the joint attrition of water and fine mud into which their bodies were borne, these jelly-like remains were rolled out of all semblance to their original organic shape, and then, by the strange chemistry of the period, became each a nucleus to which were attracted the minute particles of iron converting their remains into the substances and shapes they now bear?

These thoughts suggested themselves at various times before the finding of the tracks in the same bed by the singularly animal-like shape of some of the nodules previously met with. "Accidental" shapes they may have been, as I could find no trace of tooth, claw, or bone of any kind, yet this does not discourage me from holding to the firm belief, amounting almost to conviction, that such discoveries will be made, and by the calling of attention to this point by men of acknowledged scientific character, others may be led to examine more closely these singularly sown nodules and yet more conclusively than these few tracks, establish beyond dispute the existence of animal life in abundance during the period of the formation of coal.

The tunnel driven through Big Lick Mountain, at the Summit Branch Colliery at this place (Williamstown), furnished me at one time with a specimen of more interest, if possible, than the saurian foot-marks from the Mahanoy Valley, being no less than a sandstone cast of the head of the thigh bone of some animal that had evidently been of large size, the cast having been over four inches in diameter, and nearly ten pounds in weight. It was presented to me by Mr. Daniel James, the foreman of the gangs of men driving the tunnel from the south side. He could not find a trace of the other portion, as it had been thrown out by a blast, although he searched carefully. In appearance the cast had a striking similarity to the head of the femur in a human skeleton and was almost perfect, owing to its great hardness and the hard character of the surrounding rock, some of which clung to it most tenaciously and could not safely be removed by hammer and chisel. Unfortunately it went astray by getting into the hands of some unprincipled individual during transmission to the Society of Natural Sciences at Reading, to which my design was to present it, and only the memory remains.

This most interesting cast was from a "slip," in excessively hard rock lying north of what is here known as the "Whites" vein or seam of coal, hundreds of feet beneath the mammoth, but overlying the Lykens Valley seam. As I preserved no record or drawing of this find, it is only by a draft upon memory to give an indistinct idea of it in a rude drawing as this * * * *

The cast was a fine-grained, very compact sandstone, wholly different in texture and color from the surrounding rock of the "slip," which was over a hundred feet beneath the surface of the mountain and several hundred yards from the southern opening of the tunnel, so that, without an opening to the surface, which there was not, it could not reasonably be suspected to have been the remains of an animal dropped in from the surface. This was in the summer of 1872, but the impression it then created was very strong and its appearance still remains vivid in memory.

Respectfully, &c.,

WM. D. H. MASON.

WILLIAMSTOWN, DAUPHIN CO., April 4, 1878.

Prof. Prime exhibited photograph pictures of limestone (*Siluro-cambrian*) outcrops along the west bank of the Lehigh River above Allentown, which evidently verify Prof. Rogers' hypothesis of the cause of the general south-east dips which prevail through the Great Valley. In these pictures a number of local sharp overthrown anticlinal rolls or saddles are beautifully exhibited.

Prof. Frazer remarked that he had just completed his Susquehanna river section in Lancaster County, through the same limestone formation, and was surprised to find evidence in its construction, of very broad and regular anticlinals with opposite dips; the whole limestone series measuring more than 3000 feet; a measurement corresponding very well with that of the limestones in York Co.

Prof. Prime said that he could not obtain more than 2000 feet of limestones in the Lehigh region.

Prof. Houston described some improvements which he and Prof. Thomson had been making in the form of the telephone.

Pending nominations Nos. 852 to 856 were read and balloted for, and No. 857, and new nominations Nos. 858 to 863 were read.

On motion of Dr. LeConte, the consideration of Prof. Cope's resolution was again postponed, on account of his absence.

The ballot boxes being scrutinized by the presiding officer, the following persons were declared to be duly elected members of the Society:

852. C. Newlin Peirce, D.D.S., Philadelphia.
853. Rob't H. Alison, M. D., of Philadelphia.
854. Wm. D. Marks, Prof. Mech. Eng., Univ., Pa.
855. Lewis M. Haupt, Prof. Civ. Eng., Univ., Pa.
856. Burt G. Wilder, Prof. Anatomy and Zoology, Cornell University at Ithaca, N. Y.

And the meeting was adjourned.

Stated Meeting, May 17th, 1878.

Present, 17 members.

Vice-President, Mr. Fraley, in the chair.

Dr. Wormly, Prof. Marks and Dr. Alison, newly-elected members, were introduced to the presiding officer and took their seats.

Letters accepting membership were received from Mr. Andrew Sherwood, dated Mansfield, Pa., May 4, 1878; Prof. Wm. D. Marks, dated Univ. Pa., May 7, 1878; Prof. Lewis M. Haupt, dated Univ. Pa., May 7, 1878; Dr. Robt. H. Alison, dated 250 S. 17th street, Philadelphia, May 8; Dr. C. Newlin Peirce, dated Philadelphia, May 8, 1878; and Prof. Burt G. Wilder, dated Ithaca, N. Y., May 9, 1878.

Acknowledgments of the receipt of diplomas of membership were received from the Hon. Craig Biddle, Mr. Edward Penington, Mr. H. Armitt Brown, Prof. Thos. M. Drown, Mr. John F. Carll, Prof. J. L. Campbell, Hon. M. Russell Thayer, Mr. C. V. Riley, Mr. Samuel R. Langley, Mr. Gideon E. Moore, Mr. I. H. McQuillen, Prof. C. F. Brackett, Dr. Wm. Goodell, Mr. Chas. E. Hall, Mr. A. R. Grote, Prof. T. F. Crane, Prof. H. T. Eddy, Mr. Andrew Sherwood, Mr. J. M. Hart and Mr. John McArthur.

Acknowledgments of the receipt of numbers of the Proceedings were received from Prof. L. Rütimeyer, dated Basel, February 5, 1878 (99); the Lit. and Phil. Society of Liverpool, Jan. 31 (99); the Smithsonian Institution, April 3 (100); the McGill University, May 6 (100); and the New Bedford Library, May 11 (100).

Envoys were received from the Societies at Nuremberg, Göttingen and Liverpool; the Academies at Vienna and Rome, and the Department of the Interior at Washington.

A letter of thanks to the Society for the planting of trees on the University grounds, was received from Mr. Cadwallader Biddle, Secretary of the Board of Trustees of the University of Pennsylvania, dated May 8, 1878.

Donations for the Library were received from the Horticultural Society at St. Petersburg (Aeta Horti); the Academies at Vienna, Berlin, and Rome; the Societies at Göttingen, Nuremberg and Liverpool; the Revue Politique and London Nature; the editors of the Revista Euskara at Pamplona; Victoria Institute and John J. Bigsby of London; Geological Society at Glasgow; Edinburgh Observatory; Boston Natural History Society; Dr. J. S. Newberry; New Jersey Historical Society; Penn Monthly, Medical News, Journal of

Pharmacy, Franklin Institute, Zoological Society, and Prof. E. D. Cope, of Philadelphia; U. S. Department of the Interior; University of Virginia; Botanical Gazette; Davenport Academy of Natural Science, and the Commissioners of the Argentine Republic at the Centennial Exhibition of 1876.

The death of Prof. Joseph Henry, Secretary of the Smithsonian Institution, at Washington, May 13th, 1878, aged 81 years, was announced with appropriate remarks by Mr. Fraley.

Mr. Roberts added his reminiscences of Mr. Henry at the meeting of the British Association at Liverpool, in 1837, and described a characteristic scene between him and Dr. Dio. Lardner, and the cordial reception of Mr. Henry, by the distinguished members of the Association then present; the commencement of many warm and lasting and honorable friendships.

On motion Mr. Fairman Rogers was appointed to prepare an obituary notice of the deceased.

The death of Mr. Robert Frazer, at Philadelphia, May 4th, 1878, aged   years, was announced by the Secretary.

On motion Mr. Persifor Frazer, Jr., was appointed to read an obituary notice of the deceased.

A letter to the Secretary respecting an extract from a paper on Gas Analysis, by Prof. Sadtler, published in the Proceedings under date of April 6th, 1878, was received from Prof. Henry Morton, dated Hoboken, N. J.

MAY 15, 1878.

To the Secretary American Philosophical Society.

DEAR SIR:—In a printed copy of a paper "On the calculation of Results in Gas-Analyses," read before the American Philosophical Society, April 5, 1878, by Professor Samuel P. Sadtler, which I have just received, I find the following statement:

"In a private letter to Professor Morton, dated December 31st last, in answer to one received from him a day or two before, calling my attention to the error, I acknowledged the error of the formula used by me in my printed paper, and mentioned that I was proposing to rectify the result as first published by the aid of other tests."

Professor Sadtler is here no doubt quoting from memory, and does not intend to state what is not true, but as the statement is not only incorrect, but by reason of its inaccuracy casts a reflection upon me, I feel bound to call for a correction. Professor Sadtler's letter of December 31st is now before me, and the only passage having any reference to the matter reads as follows:

"About the formulæ, I am sorry that my first mistake still stands on record uncorrected. I had copied the formulæ I first used from Foucou's article on analyses of 'Pennsylvania Natural Gases' in Comptes Rendus, and in my second lot of analyses made for the Survey, I corrected it, and corrected the first lot at the same time." This includes every word which this letter contains on the matter referred to, and while it may be that Professor Sadtler at the time of writing knew all about the matter, there was certainly nothing whatever to imply that such was the case in what he here states. On the contrary, when it is known that Foucou's article, in the Comptes Rendus referred to, contains *no formulæ whatever*, and that no *correction* of analyses was possible for the simple reason that the correction of the error showed *any analysis* to be impossible except by discovering a new method, it will appear that I had good cause to believe that Professor Sadtler was entirely in the dark upon the subject.

As to the assertion that he said in this letter "that (he) I was proposing to rectify the results as first published by the aid of other tests," it is simply a lapse of memory on his part, as nothing of the sort exists in the letter.

In a memoir by Fouqué (not Foucou), immediately following that of Foucou in the Comptes Rendus, we *do* find formulæ in some sort resembling those used by Professor Sadtler, but *not* containing his error. Fouqué's formulæ are in fact perfectly correct, and so are his results, his only fault lay in failing to perceive that hydrogen might be regarded as a lower member of the marsh-gas series,* and thus find a place in his general equation.

Yours respectfully,
HENRY MORTON.

Prof. Sadtler, to whom the letter had been shown previous to the meeting, read a written reply to Prof. Morton's statements.

In the letter from Professor Morton just read before the Society, he quotes from my paper read here on April 5th, the paragraph relating to the correspondence which passed between us about December 31st last, and supposes that I was quoting from memory. This is certainly true. I had not copied the letter, as it was regarded by me so entirely one of friendly correspondence, that I deemed such a step unnecessary. My recollection of my words must therefore have been an incorrect one when I supposed that with my acknowledgment of the error I mentioned the test proposed by me in September last here before the Society. I certainly have been under the impression that I alluded to them in writing to him at that time. In this point then, I have done Professor Morton an injustice. I must still rely on my recollection of what I wrote in that letter, but I do not think I alluded to Foucou's article at all in writing to him. I think, if Professor Morton would look at my letter again, he will see that I alluded to Fouqué's article. It would have been absurd for me to have appealed to Foucou's article as that was a geological one, and dealt only with the matter of the occurrence of these natural gases. The article of Fouqué, which follows it in the Comptes Rendus, on the other hand speaks of the analysis of these gases, and gives equations for such analysis. So what Professor Morton says in italics, viz.: that the article of Foucou referred to "contained *no formulæ whatever,*" is true, but has no bearing upon the question at issue. I have alluded in every paper which I have published on this matter, including those in Professor Morton's hands at the time of his first writing, to Fouqué's formulas and his article, found in Comptes Rendus, Vol. 87, p. 1048, and not to Foucou's article, found just before it on page 1041. In my last paper, read here on April 5th, I quote Fouqué's language on the subject just as it appears in the original French, and I think the words are capable of but one interpretation, viz.: that which I gave them. That Fouqué was in error, and that I fell originally into the same error, does not make me guilty of a willful prevarication in this matter of quoting Fouqué.

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* As was first pointed out by Mr. Wm. E. Geyer and myself in our paper in the Gas-Light Journal, February 16th.

Professor Morton says that "Fouqué's formulæ are in fact perfectly correct, and so are his results, his only fault lay in failing to perceive that hydrogen might be regarded as a lower member of the marsh-gas series, and thus find a place in his general equation."

Professor Morton, in calling attention to my errors, seems to me to be willing to let Fouqué off much too easily. His fault is greater than that here indicated. Fouqué literally translated says, "a mixture of these carbides with free hydrogen *prevents* this condition from being realized. It is therefore easy to recognize if a mixture of gaseous hydrocarbons consist exclusively of carbides of the formula $C^n H^{2n + 2}$." He therefore not only "fails to perceive that hydrogen *might* be regarded as a lower member of the marsh-gas series," to use Professor Morton's words, but says distinctly that its presence interferes with the realization of an equation characteristic of the marsh-gas hydrocarbons as a series.

I have no desire to shield myself behind Fouqué's faults, but I wish to be given credit for a faithful interpretation of his language, and for a willingness to acknowledge my errors when they are pointed out.

The Secretary exhibited by permission of Mr. Lorenz, Chief Engineer of the Reading R. R., the stone slab from the Ellengowan Colliery shaft, bearing the Batrachian foot-prints mentioned at the last meeting, and referred again to the letter of Mr. Mason, its discoverer. Mr. Lesley stated that he understood Mr. Lorenz to wish to propose for it the name Anthracopes Masoni, provisionally, until the discovery of other foot-prints or remains of the animal, should give occasion for a better determination of genus or species.

Mr. Frazer exhibited what is perhaps the first perfectly successful electrotype of a piece of a phonograph ribbon, made by Mr. Edison.

Mr. Frazer described ripple-marks on a slab of limestone from the Siluro-Cambrian region of Lancaster county, and Prof. Prim added that such ripple-marks entirely cover the exposed surfaces in the Euhlersville Quarry, in Northampton County; these beds being also of Calciferus sandstone age.

Mr. Frazer then drew attention to the great significance and geological importance of his recent discovery of an immense anticlinal, crossing Lancaster county, and probably traversing York county into Maryland. He called it the "Martic" anticlinal, and showed how it exposed fundamental gneiss and granitoid beds in the new railroad cuttings along the left bank of the Susquehanna river; how it sheds off to the north and to the south at least 16,000 feet of primal (Cambrian?) slates; and how its eastern prolongation, would cross Lancaster country into Chester county, where the uplift seems to be represented by the fundamental gneiss series of the Welsh Mountain.

The minutes of the last meeting of the Board of Officers and Council were read.

Pending nominations Nos. 857 to 863, and new nominations Nos. 864 to 869 were read.

Prof. Cope called up his motion of April 5th, which after discussion, was, on motion of Mr. Lesley, indefinitely postponed.

And the meeting was adjourned.

Stated Meeting, June 21st, 1878.

Present, 16 members.

Vice-President, **Mr. Price**, in the chair.

Dr. Pierce, a newly elected member was introduced and took his seat.

The resignation of Mr. J. Imbrie Miller was received and accepted.

Photographs were received from Mr. I. Louthian Bell, dated Rounton Grange, Northallerton, England, May 17th, and of M. M. Chevalier, and Mr. Moncure Robinson, from the latter.

Letters of acknowledgment were received from R. I. Kinderdine, Furman Sheppard, R. W. Raymond, H. S. Hagert, W. P. Tatham, W. A. Ingham, W. M. Roberts, W. B. McKean, F. Prime, Jr., C. W. Shields, R. Thayer, and Elihu Thomson (Diplomas). Also from the Nassau Association (90 to 99); Luxembourg Institute (96, 98, 99), and the Davenport Academy (81 to 100).

Letters of envoy were received from the Royal Academy, Stockholm, and Royal Academy, Lisbon.

A circular letter of invitation to the funeral of Isaiah Thomas, was received from the Mayor of Worcester, Mass. Chairman of a Committee of Invitation; the funeral to take place June 24th. A donation of $500 to the American Philosophical Society is mentioned among the bequests in the will of the deceased. On motion the Secretaries were requested to respectfully reply.

Donations for the Library were received from the Academies and Societies at St. Petersburg, Moscow, Copenhagen, Berlin, Leipsic, Frankfort, Wiesbaden, Luxembourg, Lausanne, Rome, Lyons, Cherbourg, Dijon, Lille, Bruxelles, and Salem, Mass.; also from the Observatories at St. Petersburg, San Fernando, Oxford University, and Mexico; also from the Statistical Bureau at Stockholm; German Geological Society; Magazine of General Science, Berlin; Prof. Rütimeyer; the Geographical, Anthropological, Antiquarian and Medical Societies of Paris; Annales des Mines and Revue Politique; the Geographical, Physical and Linnean Societies at Bordeaux; the Royal Institution, Zoological, Geographical and Astronomical Societies in London; Journal of Forestry and Nature; the Canadian Naturalist; Cambridge M. C. Z.; Boston N. H. S; Appalachian Club; Massachusetts Board of Health; Silliman's Journal; Franklin Institute, Journal of Pharmacy, Medical News, Penn Monthly; Historical Society, Pa.; Geological Survey, Pa.; Judge Kelly; S. H. Scudder; U. S. Fish Commissioners; Wisconsin N. H. Association; Botanical Gazette; Min. de Fomento of Mexico; and the Cincinnati N. H. Society.

The Librarian displayed a set of 21 colored plaster casts, or imitations of original Archælogical American specimens, in Prof. Guyot's Museum at Princeton College, N. J., made by Prof. Matile, and presented to the Cabinet of the American Philosophical Society, by Prof. Guyot, as a return for the permitted copy of many of the antiquities in the Cabinet, for the use of the Museum at Princeton. On motion it was resolved that the thanks of the Society be tendered to Prof. Guyot and Prof. Matile for this beautiful addition to the Society's collections.

The Librarian reported that Part III of the *Catalogue* was printed and ready for distribution; including Class VI, Sociology, Manufactures, Commerce, War and Law; making a volume of 300 pages, bringing the running folio up to page 942. On motion the distribution was ordered.

The decease of Mr. Wm. M. Gabb, at Philadelphia, May 30th, aged 39, was announced with appropriate remarks by Dr. Horn, who, on motion, was appointed to prepare an obituary notice of the deceased.

Prof. Chase communicated a paper, entitled "On rotation and radiation."

Dr. Weir Mitchell, communicated a paper, entitled "The effect of Irrelation of a polarized nerve, Pflüger's Electrionus; by B. F. Lautenbach, M. D., Ph. D." (165 Mss. pp. of text and tables.) Referred to the Secretaries.

Mr. Blodgett exhibited and described a number of specimens of copper-silver ores from the mines of Huantajaya in Peru, on the borders of Bolivia, 8 miles back from the coast at Iquique, and 1° west of Potosi; 2560 feet above tide; collected by, or under the direction of Governor Prado of Peru, and sent to Philadelphia, in pursuance of a plan for closer commercial intercourse between Peru and the United States. Mr. Blodget exhibited charts, showing the situation of the mines; and also the positions in the interior where newly discovered valuable deposits of gúano were now exploited for commerce.

Prof. Halderman read a paper for the Transactions, on aboriginal relics of great age found in 30 inches of earth, in the small cave near his house, at the base of Chicques rock, on the east bank of the Susquehanna river, above Columbia, in Lancaster county, Pennsylvania; and exhibited a selection of them arranged classically on 14 cards, to be drawn and printed in illustration of his memoir. On motion it was referred to a committee consisting of Dr. Daniel G. Brinton. Prof. Jos. Leidy and Prof. Lesley.

Prof. Houston exhibited a microphone relay made by himself and Prof. E. Thomson of the Philadelphia High School, to be applied to Bell's articulating telephone.

Prof. Barker exhibited a suite of Mr. Edison's instruments invented and made by him during the last year or two, and showed that there was nothing original in any of the inventions of Mr. Hughes ("Prof. Hughes") of London.

Dr. Sadtler communicated a paper entitled "Contribution No. XIV, from the Laboratory of the University of Pennsylvania, A new monochlordinitrophenol and an aniline derivative of the same. No. 2, On Beryllium borate," by Edgar F. Smith.

Pending nominations Nos. 857 to 869 and new nomination No. 870 were read.

And the meeting was adjourned.

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ERRATA.

Page 537, line 13th from top, for "*thousandth,*" read "hundredth."

Page 539, "Pints, Liters," strike out "a" in second line.

Page 625, line 3 from bottom, for "opaciollis," read "opacicollis."

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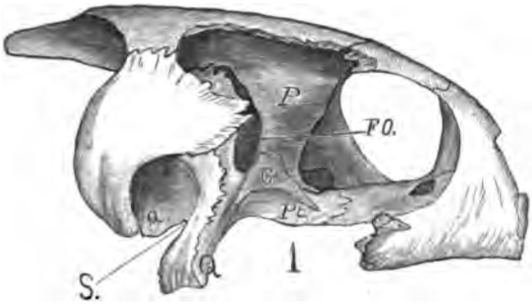

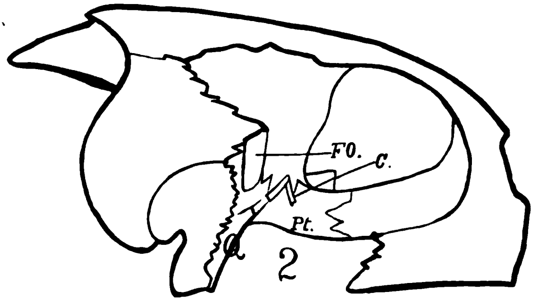

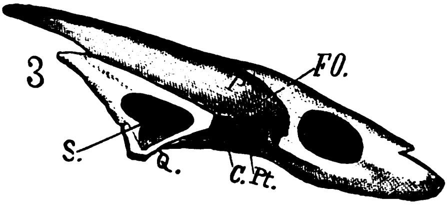

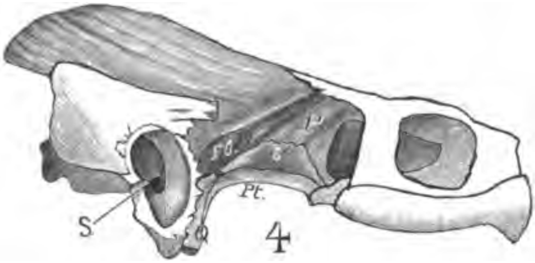

Fig. 1. Ch. mydas. (Post-frontal, jugal, and quadrato-jugal removed.)

P.—Parietal. Pt.—Pterygoid. F.O.—Foramen Ovale.

C.—Columella. Q.—Quadrate. S.—Opening for Stapes.

(Letters alike for all figures.)

Fig. 2. Ch. mydas. (Young.) Fig. 3. A. spinifer. Fig. 4. Ch. serpentina.

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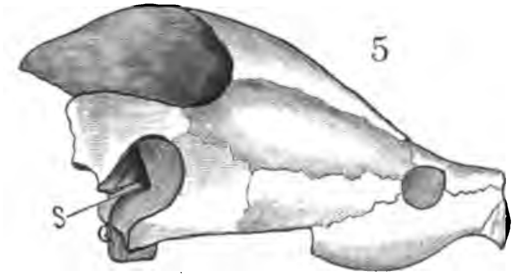

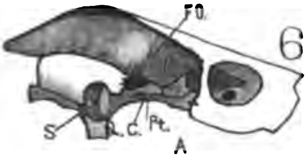

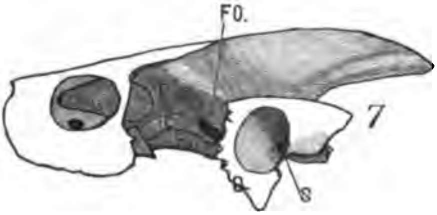

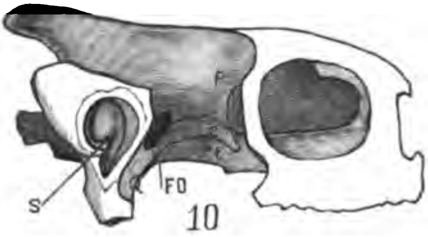

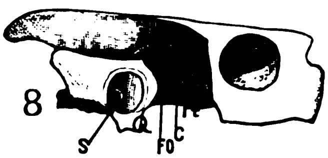

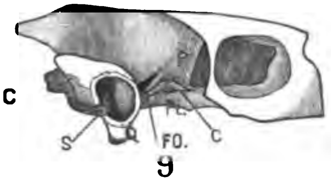

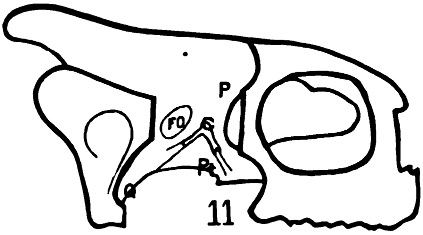

FIG. 5. M. LACERTINA. (After Gray.)

FIG. 6. A. ODORATUS.

FIG. 7. M. PALUSTRIS.

FIG. 8. CH. INSCULPTUS.

FIG. 9. C. CLAUSA. (No zygomatic arch.)

FIG. 10. T. CAROLINA.

FIG. 11. T. CAROLINA. (Young.)

UNIV. OF MICH.

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